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NOTES AND COMMENTS

VACCINATION

It is the plain duty of every scientific journal at the present crisis in the history of vaccination, to put before its readers a clear statement of the facts at issue. But it must not be forgotten that two very distinct questions are involved: the efficacy of vaccination is one thing, the expediency of compulsory vaccination is another.

The efficacy of vaccination in preventing small-pox is a scientific fact, established by evidence as clear as any in the range of our knowledge. We do not, nowadays, pause to argue with a man who says the earth is flat. No level-headed person with any capacity for weighing evidence doubts that vaccination, efficiently performed, affords an almost absolute protection against small-pox for a term of five to ten years, according to the natural susceptibility of the individual—that after this period the protection gradually fades, though, in most cases, persisting in some degree throughout life—and that it may be renewed by re-vaccination. Vaccination has been the main agent, in this and other countries, in reducing small-pox mortality to its present low level, and it has done so by abolishing the excessive infant mortality from the disease which prevailed in pre-vaccination times. Statistics show clearly enough that small-pox mortality in any country diminishes strictly in proportion to the extent to which vaccination is carried out. In proportion as re-vaccination is universal, small-pox is reduced to the vanishing point. What mortal man could do in discrediting vaccination was done in the minority report of the recent vaccination commission, an ingenious and plausible piece of special pleading, which was absolutely torn to pieces by Dr McVail in his paper read before the Epidemiological Society shortly after.

We take the propositions we have mentioned above as axioms, and we are not concerned to defend them in this place. Their scientific basis rests on the principle that the virus of an infectious disease may be so diminished in effect, by passage through a relatively insusceptible animal, as to produce a mitigated form of the affection, capable, nevertheless, of conferring protection against

the acute disease in its unmitigated form. The recognition of the fact that vaccinia is merely attenuated small-pox—proved now again and again—only brings vaccination into line with what we know of other protective inoculations.

There is, on the other hand, a certain price to be paid for the protection afforded by vaccination. It is the exaggeration of this price which forms the stock-in-trade of anti-vaccinators. The conceivable risks of vaccination are: (1) the constitutional disturbance produced by even an attenuated specific disease in a weakly child; (2) the introduction of some other disease from the vaccinifer in arm-to-arm vaccination; (3) the introduction of pyogenic cocci, normally present in all lymph, and notably in calf-lymph; and (4) the risks attending every scratch on the skin, especially when the recipient of the scratch lives under insanitary conditions. Of the above risks, No. 1 is already largely met by the medical postponement of vaccination in unsuitable cases: it is an infinitesimal risk, but it exists. No. 2, as vaccino-syphilis, is the prop and stay of every anti-vaccinator: authentic cases of this accident are on record, though every medical man knows that the vast majority of supposed cases are in reality examples of congenital syphilis, manifesting itself, as it commonly does, about the time when vaccination has to be performed—the latter serving as a convenient scape-goat for parental sins. This risk is abolished absolutely by the proposed use of calf lymph only. No. 3 is probably an imaginary risk: an exhaustive study of the matter in Germany shows that the course of vaccinia is little, if at all, influenced by the presence of pyococci. In any case the use of glycerinated lymph will abolish what risk exists. There is a strong presumption, based on the observations of Klein, and later on those of Copeman, that the specific virus of small-pox and vaccinia is a spore-bearing bacillus. It has been shown by German observers, and in this country especially by the elaborate researches of Copeman, that, by the admixture of vaccine lymph with diluted glycerine, adventitious organisms are gradually killed off—the more resistant vaccinia virus, presumably in spore form, remaining alone, but retaining its full potency. Such glycerinated lymph may already be obtained in the market, sterile to ordinary bacteriological cultivation, and it is such lymph that the State proposes to offer. Risk No. 4 is untouched by the present bill: it is a question of ordinary cleanliness. Erysipelas may follow an almost microscopic lesion of the epidermis. In practical life we despise such risks, and we can afford to do so.

Even as matters stand under the present laws, the mortality from vaccination is exceedingly minute. Compared with the enormous infant mortality from small-pox in the pre-vaccination era it is infinitesimal. With the introduction of glycerinated calf

lymph the standard objections of the anti-vaccinator are done away with, at least to the unprejudiced mind. The duty of the State is clearly to secure not only the primary vaccination of the largest possible number of infants, but also the re-vaccination of the entire population at the age when the effect of primary vaccination may be presumed to have worn off. This is the verdict of science, and here the functions of science cease.

How all this vaccination may best be secured is a question of practical politics, hardly suited to the columns of a scientific journal. We may state, however, that we can see no logical halting-place between stringent compulsion and the repeal of the Vaccination Acts. For stringent compulsion it may be urged that risk of small-pox is one that affects not so much the man who refuses to have his child vaccinated, as his child and his neighbours, and that in other respects we do not hesitate to coerce the individual for the benefit of the community. But it may be fairly argued, on the other hand, that compulsion has been tried, and has failed; and that the remedy lies in education. The "conscientious objector" conscientiously objects in strict proportion to his ignorance and inability to weigh evidence: he is at the mercy of the irresponsible faddist, who deluges him with fallacious argument and *ex parte* statements. Were the money necessary to secure compulsory vaccination spent in a reasonable system of education of the masses as to the value of vaccination—a matter now entirely neglected—it is possible that in the long run a larger percentage of vaccinations might be secured than under the present unsatisfactory system, or under the illogical makeshift proposed by the present Government.

CHRISTMAS ISLAND

MR C. W. ANDREWS, of the Geological Department of the British Museum, has returned from Christmas Island (the one south of Java, in about 10° S. and 105° E.) after an absence of fifteen months, ten of which were spent on the island itself. This prolonged stay has enabled him to make fairly complete collections of the flora and fauna, and also to explore and examine the structure of nearly every part of the island. This, Mr Andrews informs us, is very interesting from a geological point of view. It appears to be probably a raised atoll, the central plateau of which is the old lagoon, while the elevations which occur round this are the remains of the islands. Coastwards the land descends in most places by a succession of three or four cliffs, separated by terraces of varying width. In some places these cliffs unite, forming a lofty precipice some 500 feet in height: in these places good sections showing the structure of the island can be seen. At Flying Fish Cove the lower five hundred feet consist of alternations of volcanic rock and foram-

iniferal limestone, above which coral reefs occur. The whole island is thickly covered with forest and jungle, and locomotion is very difficult or even, in places, impossible. The soil is very rich and full of phosphate of lime, beds of which occur on the tops of some of the hills. There are only a few indigenous species of birds and mammals, but these occur in great numbers, rats, particularly, being very unpleasantly numerous.

On the coast immense numbers of frigate birds, tropic birds, and gannets nest in the tall trees. The first named are perhaps the most numerous, and form the chief food-supply of the island. There was an excellent opportunity of observing the remarkable breeding habits of these birds. There are several species of land crabs, including the large *Birgus latro*, which is very numerous over the whole island. These crabs, like the rats, are excellent climbers, and go high up the trees in search of food, and both are a great nuisance to any one camping in the bush. Mr Andrew Ross has lived on the island for some years, and has planted cocoa-nut, bananas, papaias, and other useful plants, and the supply of food is now abundant. Since the climate is very healthy and not too hot, there are many worse places of residence than Christmas Island.

NOTES ON SEA-FISHERIES

THE *Report* for 1897 of the Lancashire Sea-Fisheries Laboratory gives every promise of valuable results being obtained in fishery investigations. As pointed out by Professor Herdman, the founding of a laboratory at Piel should enable certain problems, such as those connected with the feeding, breeding and life-history of shellfish, to be taken in hand at once, besides giving opportunities for artificial cultivation, should such be deemed desirable. As regards work upon the food-fishes themselves, the pioneer work has been accomplished elsewhere, and such institutions as that at Piel, beginning where others have left off, should be able to make rapid progress. For example, if the investigations at Piel could be definitely directed to the carrying out of a "scientific experiment which," to quote Professor Herdman, "would gauge the extent of the results of artificial hatching in a given area," they would justify any reasonable expense involved. This investigation might perhaps be carried out in a simpler manner than that suggested by Professor Herdman. Two circumscribed sea-areas, of which the average fish population is to be determined, and ten or more years for experiments are almost unattainable conditions. It is a question how far the importation and cultivation of varieties from another district, the local presence of which at later stages could be readily determined, would solve the difficulty. At least this would be an experiment worthy of adoption.

Another question pressing for scientific solution is the condition of the fisheries relatively to former years. There are many factors which beset this question with difficulty, but there is no doubt that in certain districts, for one reason or another, there has been a diminution of the fish-supply. From Jersey, for example, comes a plain statement by Mr Hornell upon the decadence of the local fisheries (*Nouvelle Chronique de Jersey*, March 1898). This was further borne out by the statements of Mr Renouf at the meeting of the 'Etats' and resulted in the appointment of a special committee to consider the whole subject. In this particular instance the decadence is, according to Mr Hornell, more due to local destruction of young fish than to the more customary British scapegoat, the trawler.

The April number of *La Pisciculture Pratique* contains the presidential address of the 'Conseil supérieur de Pisciculture.' Mr Bellesme has to repeat the old tale of science *versus* politics. His indictment against those in political power is sweeping but perhaps not undeserved. "All their actions are subordinated to the desire of remaining in power and of providing handsomely for their families and for those who keep them at the top of the tree." This is without doubt, telling the truth "franchement et sans circonlocution." The June number contains a very interesting article in connection with the successful introduction of the Californian salmon. At Vicence, the young salmon of 1895 have been reared in a lake near the laboratory and artificial propagation from these is now about to be attempted. Mr Bellesme, in an able paper, points out the method of procedure which should be adopted in order to ensure success. The same writer contributes a general account of the rearing of larval fish.

STEAM-TRAWLING OFF JAMAICA

THE Carribean Sea Fisheries Development Syndicate, Limited, is an imposing title. The body bearing this name was subsidised by the Jamaica Legislative Council for 1896 to institute preliminary experiments with a steam trawler in Jamaican waters. Jamaica has to draw very largely upon Canada and the United States for its fish-supply, and it was thought that the adoption of the latest methods of steam trawling in the local waters might be attended with success in the way of profit to those pursuing the industry and of gain to the community of the island. To this end the steam trawler "Capricornus," from the Iceland Fisheries, equipped with well, otter-trawl, and a Grimsby crew was chartered and worked through the district for nearly three months. The record of the log demonstrates pretty clearly that the method of steam trawling is impracticable for this area. The customary ending to each haul appears to have been a torn net, and the actual number of fish caught seems to have been

very small. These results are due, on the one hand, to the luxuriant growth of corals, and on the other hand, to the actual scarcity of the bottom flat-fish or pleuronectids, which with the allied gadoids form the most important elements of our northern fisheries.

The scientific results are of some value. It is to be noted that in many cases in which the lead indicated a sandy bottom, the trawl showed the presence of dense masses of coral, a fact which should be noted by coral-reef theorists. Mr J. E. Duerden, of the Jamaica Museum, gives an able summary of the fauna. *Bergia*, an actino-zoan commensal with a sponge, was re-discovered, and sponges and alcyonarians were found in great abundance. The edible fishes were not abundant, either in actual quantity or in number of species. *Mesoprion*, *Ocyurus*, *Haemulon*, and *Serranus* appear to be the most important.

Apparently the local supply in Jamaican waters will in future, as heretofore, have to depend upon the use of lines and drift-nets.

ASCIDIANS AND BIPOLARITY

WE have more than once directed attention to striking cases of distribution, indicating some connection between the North Pacific and North Atlantic. Now comes Professor Herdman (*Trans. Liverpool Biol. Soc.*, xii., pp. 248-267, pls. xi.-xiv., June 1898) and draws up lists of closely-allied species of ascidians from Puget Sound and our own N. Atlantic coasts; similar series are, he says, shown in a subsequent paper on the Crustacea by Mr A. O. Walker. "This, taken along with the similarity between the two faunas shown in other groups, suggests the possibility that there is a common northern circum-polar marine fauna which sends extensions southwards on the western coasts of Europe and America."

Such a conception is of course opposed to the well-known hypothesis of Sir John Murray that the marine faunas towards the poles are genetically more closely related to each other than to any intervening fauna. Sir John has supported this 'bipolar' hypothesis by quotations from the reports of some of the specialists who described the "Challenger" collections. It has struck us that this somewhat crude lumping of the conclusions of many minds, expressed originally with very different ends in view, could lead to no secure result, and we are by no means surprised to find Mr Herdman commenting as follows:—"I do not know how it may be with other authors quoted, but in my case the series of short extracts given from my report require to be expanded and explained, and are then seen not to give Dr Murray's view the support which he supposes. My remarks, on p. 265 of the Report, which he quotes, refer only, it may be stated, to 'Challenger' species. In the genus *Styela*, for example, there are plenty of species known from the tropics. Dr Sluiter has described about fifteen

species from the island of Billiton, between Singapore and Java. I consider that the distribution of Tunicata as a whole does not lend any support to the bipolar hypothesis. On account of the admitted want of equivalence between the characters made use of in specific and generic diagnosis in the different groups mere lists may be deceptive, especially if drawn up and correlated by one man, who cannot possibly be a specialist on all groups of marine invertebrata. For that reason I now abstain from expressing any opinion except in regard to the group of which I have a more intimate knowledge. It seems to me that this matter must be settled by specialists in each group of animals stating their opinions as to the genetic affinities of the northern and southern faunas in their own groups quite apart from and uninfluenced by general lists containing other groups. The Tunicata instanced by Dr Murray, both in his 'Challenger Summary' and in his paper on the 'Marine Fauna of the Kerguelen Region,' help to swell lists that assume rather imposing dimensions, but when I examine the case of these species and genera of Tunicata individually, I find that the records of occurrence have to be added to or modified in such a way as to entirely change the nature of their evidence, and show that there is no such close resemblance between the northern and southern polar faunas as Dr Murray and others have supposed."

DEEP ATLANTIC HOLOTHURIANS

ANOTHER instance of similarity between N. Atlantic and Pacific forms was recently noted by Mr Rémy Perrier in his description of the deep-sea holothurians, *Elasipoda*, dredged by the "Travailleur" and the "Talisman" (*Comptes rendus Acad. Sci., Paris*, cxiii, pp. 900-903, Nov. 1896). He describes *Psychropotes buglossa* as being a near ally of *P. varipes* Ludwig, which latter was dredged by the "Albatross" north-west of Cape San Francisco at 1573 fathoms. Unfortunately Mr Perrier does not give either localities or depths of his new species, nor does he figure them; this is too much to expect in a Preliminary Notice. The chief interest of his paper lies in the rearrangement of the species of *Peniagone* and *Scotoplania* according to the nature of the calcareous spicules, and the establishment on the same grounds of a new genus *Periamna* with triradiate spicules, and having as genotype the *Peniagone naresi* of Théel.

BIPOLARITY WITH A VENGEANCE

WE are indebted to Mr Henry Champion of Birmingham for a copy of a 48-page treatise — "The Secret of the Poles" (White & Pike, price 1s.). Mr Champion recognises the impossibility of man ever reaching either pole; at the same time he appreciates the great importance that such an investigation would have, and does his

best to repair the deficiency by a bold appeal to "the possibilities of creation." The result is "frightfully thrilling." We give a few of the author's statements. "Inside the earth is a hollow region large enough to hide the moon and to spare." "The earth's axis has two openings, one at either Poles (*sic*)."

"Metic swarms and ether are attracted through the axis, as food. One supports the other. The earth does not lose weight but adds to it. Internal combustion." "All winds and tempests originate at and from the Antarctic pole." "The moon has not yet emerged into adult life. She will do so before long," and it will be "a startling epoch in our history." "The heavenly bodies will increase in number, like nebulae, and produce larger bodies." The pamphlet is furnished with a marvellous diagram of the earth in space. We may safely endorse the author's own judgment on his work, that, "whatever its defects, and they are many, it cannot be said it is wanting in novelty, for from the first page to the last the interest is fully kept up."

THE AGE OF THE ISTHMUS OF PANAMA

A RELIABLE account of the geology of Panama has long been one of the greatest of geological *desiderata*, for, in spite of the surveys for railway and canal, and the repeated traverses of the pass of Panama, it has been very difficult to obtain any satisfactory information as to the last date at which marine deposits were laid down upon the summit of the isthmus. Maack's observations have been repeatedly quoted as proving that Pleistocene marine shells occurred on the watershed, and that therefore there was a free waterway across the isthmus in recent times. This view was supported by the zoologists, who, impressed by the general resemblance between the faunas on the two sides of the isthmus, concluded that this could only be explained by a recent direct communication between the two seas. Other workers, however, after a more detailed study of larger collections, have concluded that, in spite of the generic resemblances, the species of the Carribbean and Pacific are almost entirely different, and that therefore the two oceans have been separated for a considerable period. All students of West Indian geology will therefore be very grateful to Professor Alexander Agassiz, who sent Professor R. T. Hill to Panama to settle this question by direct evidence, so that we are no longer dependent on the inferential methods that hitherto have been only available. Professor Hill's report has been issued as one of the *Bulletins* of the Museum of Comparative Zoology (vol. xxviii, No. 5). It is entitled, "The Geological History of the Isthmus of Panama and portions of Costa Rica; based upon a Reconnaissance made for Alexander Agassiz." The report is accompanied by contributions from Dr Dall, Mr T. W. Vaughan, Mr R. M. Bagg, and others, and is illus-

trated by nineteen admirable plates. Professor Hill's work now conclusively demonstrates that there has been no connection across the Isthmus of Panama since the Oligocene period, and that there has not been any very extensive submergence in post-Jurassic times. The connection between the Carribbean and the Pacific must be restricted to a very limited connection in the Eocene and Oligocene epochs. All the interesting theories which explain English glaciation by a Pleistocene submergence of the Panama, and consequent diversion of the Gulf Stream, may therefore be finally dismissed as apocryphal.

MIGRATION AND HOMOTAXIS

GEOLOGISTS know well enough that identity of species in widely separated fossil faunas does not imply identity of age, since time must be allowed for the species to have migrated from one locality to the other. It therefore becomes important to know the actual rate of migration of marine species at the present day. Opportunities of observation are not often presented. One occurred when the Suez Canal put the waters of the Mediterranean into communication with the Red Sea. Another began on Feb. 3, 1825, when the Limfjord Denmark, up till then a fresh-water lake, became connected with the North Sea and its fauna began to change. A study of the immigrant animals was published by J. Collin at Copenhagen in 1884, and a notice of more recent changes has recently been contributed by Th. Mortensen to *Videnskabelige Meddelelser* (1897, pp. 311-319). Since 1884 the following species are known to have entered the Limfjord: *Raia batis*, *Actaeon tornatilis*, *Clavellina lepadiformis*, *Portunus arcuatus*, *Cribrella sanguinolenta*, *Ophioglypha albida*, and *Echinocardium cordatum*. But even yet the fauna is not assimilated to that of the adjoining sea; many echinoderms have yet to find their way in, such as the sand-stars *Amphiura filiformis*, *Ophiopholis aculeata*, and *Ophiothrix fragilis*. We may expect too that some seventy species of molluscs will enter before long, for long ago when the Limfjord was an arm of the sea, and not yet a fresh-water lake, many of these species lived in it and their shells are found along its margin. In the history of the earth a century is but "a watch in the night"; nevertheless the time needed for a species to pass as it were into the next street may suggest to the geologist how long a similar form must have taken to traverse the width of an ocean.

STUDIES IN AUXOLOGY

THE growth of marine animals is a study attended with difficulty, since thorough observation of individuals is only possible in an aquarium, and there the conditions are inevitably unnatural. Dr C. G. J. Petersen, the director of the Danish Biological Station, has

shown that it is possible to estimate age by tabulating the measurements of a large number of individuals of the same species taken together. The numbers fall into groups, or are concentrated about nodes, each of which would therefore appear to represent the growth of one year. Dr Petersen himself has applied this method to fishes, but it may be used for some invertebrates, as recently shown by Dr Th. Mortensen (*Videnskabelige Meddelelser*, 1897, pp. 319-322). "Some invertebrates" we say, since *Asterias rubens*, *Echinus miliaris*, *Corbula gibba*, *Nucula nitida*, and *Carcinas maenas* resisted all Dr Mortensen's efforts to discover annual groupings. But he was able to show that *Solen pellucidus* reached its full length of 23-28 mm. in two years, while those aged one year had a length of 13-17 mm. Similarly *Ophioglypha texturata* of one year old had discs of 3-4 mm. diameter and arms 8-10 mm. long, while those of two years old had discs of 7-11 mm. and arms of 20-32 mm., and had reached sexual maturity but not yet done growing.

Here we have a field of observation open to any sea-side naturalist in want of work, and open also to collectors of fossils, who might perhaps be able in this way to throw some light on the number of years required for the formation of any given band of fossiliferous rock.

AN EVOLVING SPECIES

OVER and over again has it been objected to the theory of evolution of species that no zoologist or botanist has been able to point to the actual origin of a new species. Considering that the world has existed many millions of years, and that men have studied species for scarcely a century and a-half, the objection seems, on the face of it, unreasonable. And yet it has been met more than once. Here is one more instance of what may fairly be described as an evolving species, an instance which has the additional merit of furnishing time-data.

On the north side of Dublin Bay is a tract of sand-hills known as the North Bull, which owes its origin to the alterations caused by the Dublin Harbour works, and certainly has not existed for more than 108 years. This is inhabited now by a numerous race of mice, agreeing in general form and in dimensions with *Mus musculus*, but for the most part of a buff or yellowish-white tint, and differing further from the norm of the species in that they make burrows in the sand and construct nests at the bottom of them. This race has been described in admirable detail by Mr H. Lyster Jameson in the *Journal of the Linnean Society (Zoology)*, vol. xxvi, pp. 465-473, pl. xxx., 1898). He comes to the conclusion that the colour, which closely resembles that of the sand-hills, is a protective adaptation due to the fact that the short-eared owls and hawks which frequent the North Bull pick out the darker mice,

which, of course, are the ones more readily seen. Isolation also he regards as an important factor in intensifying the effects of competition; "the absence of direct communication with the mainland, and the consequent impossibility of frequent immigrations of dusky specimens from the houses on the adjoining shore, have allowed Natural Selection to carry on its weeding-out of unfavourable variations without disturbances of any kind."

There can be very little doubt that we have here a distinct race that has been evolved during the present century. Mr Jameson gives it no name, not even a sub-specific name, although it is at least as distinct from the species-norm as many named sub-species of *Mus musculus*. We think he is wise, for if the fashion of giving a name to every local race, confined perhaps to a few square miles as here, is to spread, we do not see where bounds are to be set. It is no absurd supposition that there may be many hundred such local races now in existence, each of absolutely independent origin, and yet not to be separated upon internal evidence. The fact is one to emphasise and to remember, but the multiplication of names is no great help.

With regard to the plate we would suggest that an actual rendering of the various colour-tints in separate squares would have been more to the point than this attempt at realism, with its dirty sand and impossible grass.

THE ROYAL BOHEMIAN MUSEUM, PRAGUE

WE have frequently referred to the remarkable progress of the Natural History Collections in Prague since they were removed to the new Royal Bohemian Museum. We have now before us the official *Bericht* of the Museum for the year 1897. Notwithstanding limited means and many discouragements, the enthusiasm of the director and his staff continues to overcome all difficulties; and those who know the collection will agree with us when we say that for convenience of arrangement and excellence of labelling it is now one of the foremost in Europe. The cases and fittings naturally lack the elegance and ornamental character of those in the larger and more richly-endowed institutions elsewhere; but so far as the original investigator is concerned, they are all admirably arranged for ready reference, while to the general scientific public they cannot fail to impart such elementary instruction as they desire. When funds fail for the purposes of this arrangement, Dr Anton Fritsch, the distinguished director, himself provides the means, and during the past year he has made a donation of 1000 florins towards the installation of the palaeontological collection. That the Bohemian public appreciate his efforts may be inferred from the circumstance that no less than 78,149 persons visited the museum during 1897;

while the list of original investigators who used the collections for research includes well-known names of several nationalities.

Among the local acquisitions during the year, one of the most remarkable is a hedgehog (*Erinaceus europaeus*), of which Dr Fritsch has published the sketch reproduced in Plate II. In this specimen there are none of the characteristic spines, the whole body being clothed instead with normal hair. Spines, of course, are only highly modified hairs, and this individual is doubtless to be regarded as an example of atavism, one in which the dermal appendages have reverted to their original condition.

Most of the acquisitions are, naturally, Bohemian or are important for comparison with specimens found in the country; for the Museum not only stores collections, but is also the central office for the geological and biological exploration of the kingdom. During 1897 Dr Počta completed the eighth volume of Barrande's well-known "*Système Silurien de la Bohême*"; Dr Fritsch studied fossil myriapods for his work on the Bohemian gas-coal, and made important geological observations on the Cretaceous rocks; Drs Fritsch and Vávra continued those researches among the organisms of the freshwater lakes of Bohemia, to which we have previously alluded; and the botanists made considerable progress in investigating the local flora, Dr Schiffner paying special attention to the mosses. The Barrande Fund was employed by Dr Perner in continuing his work upon graptolites.

We congratulate our Bohemian colleagues upon their work, and wish them the continued success they so well deserve.

THE GEOLOGICAL SURVEY

GEOLOGISTS are indebted to the Director-General of the Geological Survey for one of the most interesting and valuable publications of the year. He has decided for the future to issue an annual Summary of Progress, containing not merely the bare blue-book statistics but also a general readable account of the work of the Survey and its bearing upon previous knowledge. He makes a beginning in the Summary for 1897 now before us, which is a well-printed booklet of 176 pages and three index-maps, to be purchased through any bookseller for the small sum of one shilling. We commend it to the notice not only of those interested in our own country, but also to geologists in general who, whatever may be their special studies, are sure to find much of value in it.

This being the first publication of the kind issued by the Geological Survey of the United Kingdom, Sir Archibald Geikie has done well to preface the Summary by an introduction regarding the history and organisation of his department. This introduction occupies 30 pages, and traces the progress of the Survey from its



A HEDGEHOG: (*Erinaceus europaeus*) WITH HAIRS INSTEAD OF SPINES

(This block is kindly lent by Prof. A. Fritsch)



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inception by De la Beche in 1835 to its organisation at the present day. Some technical details as to the staff and field-work during 1897 next follow; and then the new results are summarised in readable form under the respective geological formations, taking them in order from the oldest to the newest. It is difficult to make an adequate abstract of this summary, and it must thus suffice to enumerate a few noteworthy points. Petrologists will find much important new matter in the description of the old rocks of the Scottish Highlands, while stratigraphical geologists will probably turn with greatest interest to the account of the Scottish Silurian formations, in which an entirely new fossil fish-fauna has been discovered. The recognition of Upper Carboniferous strata in the Isle of Arran is also important, although no workable coal-seams have yet been found. In Mesozoic geology there is little to record, but the memoir on the Upper Cretaceous formations is evidently making good progress. In Pleistocene geology there is a wealth of new observations, which students of the glacial period will truly welcome.

NEW SILURIAN FISHES

THE discovery of Scottish Upper Silurian Fishes mentioned above is briefly reported upon by Dr Traquair, and when fully investigated is likely to prove one of the most important contributions to Biology of recent years. Among these fossils there seems to be clear evidence of a new group of the fish-like organisms now commonly known as Ostracodermi. The new forms are indeed likely to afford important additional information as to the affinities of this problematical group, which has hitherto been best known to us by *Pteraspis*, *Cephalaspis*, and *Pterichthys*. Still more important, however, are nearly complete skeletons of the primitive fore-runners of the sharks. It has long been suspected, on theoretical grounds, that the paired fins of fishes were originally continuous lateral folds of skin supported by parallel bars of cartilage. A few years ago some approach to this condition was observed in the American Lower Carboniferous shark, *Cladoseleche*. It now appears, from Dr Traquair's brief notes, that still more important examples of the same arrangement are to be observed in the Upper Silurian genera, exactly where the primitive disposition of parts ought to be found according to theory. Biologists, will anxiously await the completed memoir on these remarkable new organisms.

EXTINCT RHINOCEROSES

THE rhinoceroses are typically Old World animals at the present day, and for many years the discoveries of fossil forms seemed to show that they had always been so. It soon became evident from fossils that the rhinoceroses could be gradually traced back both in

Europe and Asia to hornless ancestors in the Miocene period. It was thus clear that they had passed through at least the latest stages of their evolution in these regions. In 1850, however, Professor Leidy first found a fragment of a rhinoceros in the Miocene of North America; and since that time so many remains—including several nearly complete skeletons—have been found in the United States, that these great quadrupeds are now proved to have been at least as abundant in North America as in Europe and Asia, during the Miocene and Pliocene divisions of the Tertiary period. It is true, indeed, that in North America the rhinoceroses never acquired a typical horn, while they became extinct before the close of the Pliocene period; but they attained a truly remarkable development, and we now know more of the characters of the family from the discoveries made in North America than from those in Europe and India.

Professor H. F. Osborn, the well-known Curator of Vertebrate Palaeontology in the American Museum of Natural History, New York, has just begun to summarise our present knowledge of these extinct New World rhinoceroses in the first part of a beautifully illustrated quarto *Memoir* issued by the American Museum (vol. i., pt. 3, 1898, pp. 75-164, pls. xiii.-xx., April 22, 1898). It appears that three distinct groups can now be recognised, adapted for different modes of life. Firstly, there were the Upland or Cursorial Rhinoceroses, such as *Hyracodon*, all agile, slenderly-built animals, with three toes, somewhat simulating the three-toed Miocene horses with which they were associated. Secondly, there were the Aquatic Rhinoceroses, such as *Metamynodon*, with great tusks, simulating the modern hippopotamus of Africa. These were short, heavy animals, with four-toed spreading feet, and probably a prehensile lip. Thirdly, there were the True or Lowland Rhinoceroses, very abundant and doubtless similar in habit to their surviving congeners in Asia and Africa at the present day, though, as already remarked, destitute of the characteristic horn. These three groups were differentiated in North America before the close of the Eocene period, and there is already some fragmentary evidence of a similar differentiation in Europe, though the materials as yet available for discussion are too imperfect to be conclusive.

The present instalment of Professor Osborn's *Memoir* discusses the morphology of the teeth and skull of the Rhinocerotoidae, tracing the gradual divergence of the three types, occasionally obscured by parallelisms and convergences. The true rhinoceroses, Rhinocerotidae, are then discussed from the points of view of habits, geological history, and morphology, while the section ends with a preliminary bibliography that will be of much value to students. Then follows a detailed account of the hornless rhinoceroses, Aceratheres, collected

by the expeditions of the American Museum under Dr J. L. Wortman, during 1892 and 1894, from the Oligocene White River Beds of Nebraska and Dakota. These present a very large and perfect series of skulls, many of them associated with fairly complete skeletons.

Future parts of the monograph will deal with the *Aceratheres* of the American Miocene; the *Aceratheres* and *Rhinoceroses* of Europe in comparison with those of America, skeletal characters of American *Aceratheres*, and final classification of the *Rhinocerotidae*; the *Amynodontidae*; and finally the *Hyracodontidae*. Professor Osborn states that it is his one single purpose "to establish a sound philosophical basis for the morphology of the *Rhinoceroses*, derived from their primitive, parallel, and divergent characters, and leading toward the discovery of their origin, phylogeny, and distribution." If the remaining parts of his Memoir are like that now before us, he is fairly assured of success.

ON CYCLAMEN

THE well-known genus *Cyclamen* is the subject of an exhaustive memoir by Dr Friedrich Hildebrand of Freiburg, which has been recently published by Fischer of Jena. The thirteen species are almost confined to the Mediterranean region, spreading northwards only as far as southern Germany, and eastwards to the Caucasus. *Cyclamen* is a good example of adaptation to the climatic conditions prevailing in the district in question. A season of luxuriant growth alternates with a season of rest, but the determining factor is not, as in higher latitudes, the appearance or disappearance of continued frosts, but variation in the amount of moisture. Hence the most striking characteristic of this plant is the great tuber, which, like the bulb of the lily or the corm of the crocus, enables it to remain alive during the dry season. It is interesting to note that an important systematic character resides in this highly adapted structure, since in some species the tuber protects its contents by a corky layer, in others by a felt-like covering of hair. Its early development again is of great interest. The nourishment stored in a seed is generally used up on germination in the production of one or more green leaves, the assimilating organs, by aid of which the seedling becomes an independent organism. *Cyclamen*, however, has become so impressed with the importance of forming a tuber, that it starts even before the unfolding of the first leaf, which means that some of the reserve nourishment stored in the seed is not used to make leaf-tissue, but is passed down the leaf-stalk to form a new reservoir in the short stem just above the young root.

There has been much argument as to the cotyledons of *Cyclamen*. As a member of the primrose family, and, therefore, a dicotyledon, it

should have an opposite pair of seed-leaves. Gaertner, who first drew attention to this seedling, considered that the first leaf, to which we have referred, and which grows to a large foliage leaf, is the only cotyledon. Other botanists have taken the same view, while some maintain that a second cotyledon is developed later. Dr Hildebrand does not consider the nomenclature of these early-developed leaves a matter of importance, but carefully describes what happens. The development of the second leaf, presumably the second cotyledon, may be accelerated by removing the first. The author has had the inestimable advantage of observing the life-history of the species from seed to seed, and has been able to make many useful observations which would have been impossible if dried material only had been available. Among others we note an interesting correlation between the duration, or time of appearing, of the leaves and the length of the dormant period before the expiration of which this seed will not germinate.

The section on variation should be read by all who are interested in this subject, as bearing on the relation between variation and a changing environment.

The value of Dr Hildebrand's memoir is enhanced by half-a-dozen clear, double-paged plates, containing numerous figures.

THE FEMALE OF HETEROGYNA

THE recently published part 2 of the *Transactions of the Entomological Society* for the current year contains (pp. 141-150) another of Dr T. A. Chapman's valuable papers on the life-history of Lepidoptera. He describes the transformations of the South European *Heterogyna penella*—a small dusky moth with wingless female, often associated with the Psychidae which it resembles, but from its early stages apparently nearer to the Zygaenidae. The vermiform female imago remains attached to the ventral face of the pupa skin. She emerges from her cocoon for pairing, but withdraws into it again after fertilization, becoming replaced exactly in her former position in the pupa as before emergence. Oviposition then begins, and the pupa skin becomes largely filled with eggs, the shrivelled body of the female stopping up the aperture and protecting the eggs against drying up, as well as against insect parasites. Dr Chapman believes that the object of the return of the female into the pupa skin is to ensure this protection for the eggs. And maternal self-sacrifice is carried yet further, for the young caterpillars' first meal is on the remains of their parent. This concluded, they bore through the pupa skin and take to their food-plant.

I

Zoological Jamaica

THE last day of April 1896 found the Marine Laboratory of the Johns Hopkins University settled at Port Henderson, Jamaica. From the porch of the little cottage we occupied, one looks straight up Kingston harbour, where, seven miles away, lies the commercial capital of the island. Beyond the city rises Long Mountain, behind which the Port Royal hills show green and rugged; and, forming a background to the whole picture, tower the lofty Blue Mountains, with the Peak capping all. At early morning when the dawn comes up from behind that range, or late in the afternoon when the setting sun lights up with endless variety the ravines and gorges of the Port Royal hills, the scene passes description, and we constantly assured each other that a lovelier spot could not be found. Back of the cottage, the Salt Pond hills, surmounted by Rodney's lookout, separate us from the large salt-ponds, which lie a few miles down the coast.

The district around Port Henderson is one of the driest in Jamaica, and cacti form one of the most striking features of the landscape. These dry hills have a characteristic fauna, consisting largely of birds and lizards. The latter are very abundant, of half a dozen species, nearly all of which are handsomely coloured. At least two of them lay their eggs in the angles of the stem of the large cacti, called 'dildoes,' where they are safely protected by the thick, sharp thorns. Hermit-crabs and the large white land-crab are also abundant on these hills, and scorpions and centipedes are common under the rocks and logs. The white ants or termites are very common in the neighbourhood of Port Henderson and their large brown 'nests' are to be seen on all sides. These latter are excellent material, when dry, for a smudge to drive away mosquitoes, which are not wholly absent, though they seldom become much of a nuisance.

Although bats are occasionally seen at dusk and may be found in the caves during the day, the only common mammal, so far as our observations went, was the mongoose, which we often saw very near the house. The most interesting bird is a mocking-bird, peculiar to Jamaica, and said to occur at no other point on the island. The night-hawk, called by the natives 'Gie-me-a-bit' from

its very characteristic note, is common here, and occasionally the big black swift is seen near the summit of the hills. The ground-dove is very abundant and two or three other doves are common in the woods, so that their plaintive 'cooing' may be heard at almost any hour of the day. Swarms of cave-swallows breed in the numerous caves along the shore, their nests and eggs being very much like those of our common American barn-swallow.

The part of the harbour close to Port Henderson does not offer very good conditions for marine collecting, but some particular forms are abundant. The muddy and sandy bottom is literally carpeted with the commonest sea-urchin, *Toxopneustes*, and a black holothurian occurs in some numbers. The rocky shores are the homes of countless chitons of several species, and of a very lively crab, *Grapsus*, while a few species of gastropods are represented by numerous individuals. On the north shore of the harbour, which is sandy and slopes gradually into deep water, the huge star-fish, *Pentaceros*, which is so often seen as a curio in this country, is quite common, while large specimens of the shield-urchin, *Clypeaster*, called 'sea-moon' by the coloured boys, are occasionally met with.

Separated from the harbour proper by a narrow strip of sandy soil, there lies to the north quite an extent of shallow, somewhat stagnant, and near the mouth of the Rio Cobre at least, brackish water, in part filled up with mangroves. This is known as the 'Slashes.' The bottom here is stinking mud, and almost the only forms of animal life we found in the water were crab-larvae in countless quantities. Curiously enough it was in such a place that the late Dr F. S. Conant discovered great quantities of a small and exceedingly graceful Cubomedusa, which he has named *Tripedalia*. They were common among the mangrove-roots in water less than two feet deep, and they were not found anywhere outside of the 'Slashes.' The clumps and islands of mangroves are the homes of several species of herons and rails, the former called 'gaulins,' the latter 'mangrove-hens.' These swamps are rich collecting-grounds for the ornithologist, and, in the spring, for the oölogist as well.

Directly across the entrance of the harbour from Port Henderson, and a couple of miles away, lies the long low sand-spit, on the end of which stands the historic town of Port Royal. On the harbour side of this sand-spit are extensive clusters and islands of mangroves, among which are beautiful little bodies of water, connected by natural or artificial channels known as the 'Lakes.' The water in the Lakes is from two to twenty feet deep, and the bottom is usually more or less clear sand. On the roots of the mangroves, which hang down into the water on all sides, there is an abundant growth of sea-weed, with which are mingled oysters, ascidians,

sponges, and the like. No other spot that we visited in Jamaica could compare with the Lakes for abundance and variety of marine life. The sea-weed on the mangrove-roots is literally swarming with animals, and a single root would furnish profitable entertainment for hours. The sponges are of all colours and shades from black to white, red, green, blue and purple being the most striking. The oysters are small but abundant, and are said to be good eating. Beautifully coloured planarians and nudibranch molluscs are numerous both in species and individuals. One of the most interesting inhabitants of these colonies is a viviparous *Synapta*, which is abundant in certain parts of the Lakes. On dead mangrove-roots, where there is little or no sea-weed, one often finds large masses of an orange-red ascidian, which is one of the most noticeable objects to be seen. A large tubicolous annelid, *Sabella*, sometimes called locally a 'sea-hen,' is quite common, and is conspicuous on account of its large, brown and white tentacle-gills. Numerous crabs are found among the mangrove and in the sea-weed, and they form one of the most fascinating groups in the fauna of Jamaica. Over 100 species have been recorded from the island, and they differ so remarkably in size, shape, colour and conformity to their surroundings that there seems no limit to their diversity. Indeed, curious novelties in the crab line were sure to turn up on every collecting trip. We often found small fishes tangled up with the sea-weed when we lifted roots out of the water, and in this way we captured several specimens of the curious and graceful little sea-horse, *Hippocampus*. On the bottom of the Lakes the commonest animals are echinoderms, but one curious discomedusa, *Cassiopea*, is often found there, which, as it rests on the sand with its oral tentacles up, bears such a striking resemblance to a head of cauliflower that it is hard to believe it is not a vegetable growth. Several species of star-fish occur, the most striking of which are a bright red *Echinaster* and the large nine-armed *Luidia*. Two other species of *Luidia* occur, and one or two species of *Astropecten* are common. Ophiurids are represented by only a single species, and that a very small one, and sea-urchins are not very common. But holothurians abound, and are very noticeable. A few of these belong to the genus *Mülleria*, many more to *Holothuria*, but the great bulk of them to *Stichopus*. The latter show the most extraordinary variation in colour and form, so that the determination of species becomes a difficult matter. Large tectibranch molluscs, *Aplysiae* of several species, also occur in the Lakes, but they are not very common. They excrete a purple fluid into the water when they are irritated or disturbed. Sea-anemones are abundant and of several species; one genus, *Bunodiopsis*, is rather small, and covers the eel-grass in certain places with greyish-white patches. A large black ascidian is very common,

and forms quite a striking contrast to the white sand. Several species of fish occur, of which the mullet and the pickerel-like baracuda are the most sought after for food. Specimens of the curious, almost triangular trunk-fish are easily taken with a dip-net, in the shallow channels between the 'Lakes.' The remarkable fish, *Fierasfer*, was often found in the respiratory-trees of the large holothurians, especially *Mülleria*, and would only come out into the bucket or aquarium when the water became very impure.

Outside of the harbour, and several miles from Port Henderson, are a number of scattered islets known as the Cays. The largest of these are more or less overgrown with mangroves and other shrubs, but some of them are entirely bare of vegetation. They are all surrounded by reefs of coral, which are a source of unfailing interest to the zoologist. The variety in shape, colour and structure of the corals is delightful, from the massive brain-corals to the delicate feather-like alcyonarians. Inside the reefs are banks of sand, covered in most places by very shallow water, and overgrown in some spots with eel-grass. All over these sand-flats are slabs of broken coral-rock, on and under which are a great number of animals of different groups. This sort of ground makes very good collecting, Drunkenman Cay offering especial attractions. *Balanoglossus* of large size and of two or more species occurs there; and digging in the sand also brought to light several species of annelids, a small *Synapta* and a *Thallasema*-like echiurid. Nemerteans, planarians and sipunculids occur on or in almost every piece of coral, while sea-anemones abound not only among the crevices of the rock but in the sand also. Several specimens of a small octopus were seen, but they did not appear to be very common. The huge *Synapta lappa* lives under the slabs of coral, but it is not as common there as we found it to be afterwards at Port Antonio. Several other holothurians are common, including a very pretty brown and yellow *Stichopus*. Star-fishes of the genus *Asterina* are common, and show very remarkable differences in colour. They live closely attached to the under-side of the rocks, and easily escape detection. Sea-urchins are represented by several species, the two largest being especially common. One of these, *Diadema*, is almost black, and has spines six or eight inches long, while the other, *Hipponoë*, is white with very short spines. The latter is sometimes eaten by the natives, and, as a matter of curiosity, we had our cook prepare some for us; but our curiosity was soon and effectively satisfied, and sea-urchins did not appear on our bill-of-fare again. Ophiurids occur under every piece of coral, and doubtless a great many species might be obtained by careful collecting. The most noticeable form is a large *Ophiocoma*, almost black, often marked with grey or white, and with numerous short blunt spines on the arms. Two large and very

curious species of lobster occur in the deep water outside the reefs, and though they differ much from each other, they are equally different from our American species. One is very slender and graceful with very long antennae, while the other is short, thickset and clumsy with very short antennae. Neither species has large chelae on the first pair of feet. The Cays are the resorts of numerous sea-birds, especially terns of several species which breed there. The graceful and handsome man-of-war bird is common around Kingston harbour, and roosts on the Cays, as does the brown pelican, which is quite common. One does not easily tire of watching pelicans fishing, so unerring is their aim, and so remarkable the force with which they strike the water.

Almost due west from Drunkenman Cay, the shore of Jamaica is a low beach of white sand upon which *Spirula* shells may be gathered at any time. Just back of this beach lie a series of three salt ponds, which must have been connected with, and probably were a part of the ocean until quite recently. The strip of land which at the present time separates the first and largest one from the ocean has increased in width very perceptibly in the last three years. The water seems to be much more densely saline in these ponds than in the sea, and animal life is far from abundant, presumably on that account. Gastropod shells occur in great numbers, but we found very few living specimens, and almost the only other animal seen was the large medusa, already mentioned, *Cassiopea*, of which a few small specimens were observed. Crocodiles and fish are said to be abundant, but we saw only one or two of the former and very few of the latter. One of the fish, known locally as 'Calipeerer,' is highly spoken of as a food-fish, being compared to salmon. We were told that this fish is found nowhere else in the island, that it is marketed in Spanishtown in the spring only, and that no other fish in Jamaica approaches it in quality. Unfortunately we could not verify these statements, as we were unable to get either sight or taste of this remarkable 'calipeerer.'

Inside Kingston harbour the surface-collecting offers a good deal that is of interest. Several large medusae (*Aurelia*, *Cyanea*), are quite common, while on calm mornings the very graceful cubomedusa *Charybdea* is not rare. We only noted one species of ctenophore, but that is a large and beautiful form, and is quite abundant. Two or three species of *Sagitta* are very common, and the curious decapod, *Lucifer*, fairly so. Crustacean larvae were abundant, but we found echinoderm larvae very rare, no matter when or where we towed. And this seems more remarkable when one considers that echinoderms are so abundant, and that many of the species were breeding; and, furthermore, echinoderm larvae were very abundant at the same place in 1891. Dredging gave

us very little satisfaction that summer, as the only specimens we obtained, which were not collected along shore at other times, were a small holothurian and a large spatangoid. The former was dredged off Port Henderson and proves to be an interesting and probably new species of *Holothuria*. The latter, *Meoma*, were dredged outside the reef at Drunkenman Cay, and were almost the only animals which the dredge brought up from the clear sandy bottom. In the lakes and in the slashes, very little animal life was brought to light, while in the harbour proper the dredge soon clogged with the enormous quantities of *Toxopneustes*.

From Port Henderson we made collecting trips to different places, two of which are worthy of special mention. The first of these was on the last day of May, and had Montego Bay and the Bogue Islands as its objective point. Aside from the opportunity to see the central and western parts of Jamaica, this excursion proved something of a disappointment. To the east of the harbour at Montego Bay, the shore is rocky and offers very much the same collecting as that at Port Henderson, while the only new animal which the sandy beaches afforded was a large white *Hippa*. On some of the reefs and on an old pile of masonry near the middle of the harbour, a tubicolous annelid occurs which is very noticeable on account of the shape and bright colours of its tentacle-gills. There seem to be two of these, one coiled on each side in a spiral, 15-20 mm. high. They were usually green, yellow, purple or red, but often these colours would be mingled with white, so that they were very handsome objects, resting apparently on the surface of the rock. If the rock was struck, however, they all disappeared as if by magic. The Bogue Islands lie a little distance to the west of Montego Bay, and as they are covered with mangroves, the sight of them arouses expectations of collecting like that in the Port Royal Lakes. But such hopes are soon shattered, for even a careful examination fails to show any superabundance of animal life. A large buff and brown *Stichopus*, the commonest species at Port Royal, is plentiful, and the same may be said of crabs, especially 'fiddlers.' Two species of star-fish were found, and a very few *Cassiopea*. Man-of-war birds were very abundant and much tamer than near Kingston. The roots of the mangroves were in many places well covered with sea-weed, but the expected animal life was wanting. Surface towing in the evening brought to light nothing of interest. We spent one night at Montpelier, about ten miles inland from Montego Bay, and provided with an excellent hotel. An early morning ramble along a mountain brook introduced us to some interesting crustaceans and arachnoids. Small black crabs, the females of which were carrying eggs, were common among the stones, but like the shrimps, which were abundant in the

pools, they were hard to catch. Spiders of small size were common, and one large *Phrynus* was captured, carrying about a dozen large eggs on the under side of the abdomen.

Our second excursion made late in July was up Blue Mountain peak, and it was a pleasure and success far beyond our expectations. The changes in the flora as one goes upward must impress even an unbotanical zoologist, and the magnificent tree-ferns cannot be passed by in silence. As one gets well up into the mountains the clear whistle of the solitaire, not unlike that of our wood-thrush, is sure to attract attention. Some handsomely coloured finches were seen in the deepest woods, but birds did not seem to be abundant. On the summit of the peak we made a careful search for the eggs of a small tree-frog that is common there, and we were rewarded by finding many. They are laid in clusters of a dozen or more in the wet moss which covers everything. Each egg is two or three millimetres in diameter, and seems very large for the size of the animal. The scientific worker, no matter what his specialty, who visits Jamaica and fails to make the journey up Blue Mountain peak, misses one of the most charming features of the island.

In 1897 the University established its laboratory at Port Antonio, the most beautiful harbour on the north side of the island. From here trips were made east and west along the coast, and inland to Cuna-cuna Pass, Castleton Gardens and Bog-Walk. Members of the party also visited Porus and Mandeville in the centre of the island, and one party made a week's trip around the west end of the island, visiting the harbours of St Ann's Bay, Rio Bueno, Falmouth, Montego Bay, Lucea, Saranna-la-mar and Black River. The marine fauna along the whole of the north shore seems to be essentially the same as on the south side of the island, but the land fauna differs very much from that near Port Henderson. There are no mangrove swamps on the north side in any way comparable to those at Port Royal, but the collecting on the reefs is very good, and strikingly like that on Drunkenman Cay. The same star-fish, sea-urchins, ophiurids, and holothurians occur, but are more abundant and easier of access at Port Antonio. The same may be said of most of the annelids, molluscs and sea-anemones, and is especially true of the corals. Deep water is so very near to the shore that the 100 fathom line is within easy rowing distance. The richest collecting is on the sandy bars or flats in one to three feet of water, where are plenty of slabs of broken coral rock, under which an abundance of animals is sure to be found. One of the most interesting of these is a small flesh-coloured holothurian, *Chirodota*, several specimens of which were collected with the body-cavity full of young. While collecting on these flats, the small but numerous fishes, many of them gorgeously coloured, proved a great annoyance,

as the moment the rock was overturned they would rush in and seize any hapless worm or other small, soft animal which might be exposed; many fine specimens were lost in this way. Several holothurians were found at Port Antonio which were not seen elsewhere; one of them was remarkable, not only for its large size and unusual facility of locomotion, but also for its habit of eviscerating as soon as brought to the surface of the water, so that it was impossible to procure perfect specimens. Several species of echinoids, not seen on the south side, were found here, but *Toxopneustes* was comparatively rare, only a few small specimens being found. The large brown *Echinanthus* was not uncommon, and the huge *Meoma*, which we found common near Drunkenman Cay, was plentiful and was twice the size of those we saw on the south side. Two other very pretty little spatangoids, *Brissus* and *Echinoneus*, were very common in the same situations with *Chirodota*. The commonest sea-urchin was the dark reddish-brown *Echinometra*, which simply covered the rocks in some places. Some very handsome gastropods were collected on the reefs, and the large conch, the shell of which is so common in America for ornamental purposes, occurs plentifully all through the harbour. Along the sandy shore, near the lighthouse, the same white *Hippa* which we saw at Montego Bay is common, but on the shore of East Harbour, where the sand is mixed with black mud, occurs a somewhat smaller dark-brown *Hippa*, which differs from the other in habits as well as in appearance. Dredging proved more interesting than at Port Henderson, especially in East Harbour where there is a good deal of eel-grass on the bottom. Here we found large numbers of the beautiful Cubomedusa, *Charybdea*, which we rarely saw at the surface, and in the same locality the delicate olive-green sand-dollar, *Mellita*, is quite common.

The fresh-water and land fauna at Port Antonio is especially interesting on account of the numerous streams and the proximity of the hills. The streams abound with gastropods and shrimps, and large, beautifully coloured cray-fish are common. Insects are not particularly numerous or noticeable, but myriapods and arachnoids are abundant. Pseudoscorpions and pedipalps are both plentiful, and scorpions are not rare. Large centipedes with their yellow eggs, two or three millimetres in diameter, were frequently brought to us by the coloured boys, while equally large millipedes were common in the woods. Only a single specimen of *Peripatus* was found, and that was a small one; but we were told that they were not considered exceptionally rare. The land-crab at Port Antonio is very different from the one at Port Henderson, the two being distinguished as the 'black' and 'white' land-crab, respectively. Land-molluscs, especially large slugs, are very common, and the eggs of

the latter were often found in the banana 'trash.' Tree-frogs are common, especially the species which lays its eggs in the water held in the base of the leaves of the *Bromeliac*, where we often found the tadpoles swimming about. Lizards of all sorts and sizes abound, some of them being beautifully coloured. Two or three small iguanas were also brought into the laboratory, but they are rather rare. At Port Antonio we heard a good deal about Jamaica's most interesting mammal, the agouti, or, as it is more often called, the cony. It is peculiar to the island, though there is an allied species in Cuba. Though now quite rare it is still to be met with in the John Crow and Blue mountains. There are several specimens in the small menagerie of native animals kept at the Jamaica Institute in Kingston, and they have bred there. At Port Antonio we were offered a pair alive for twenty dollars, but we were unable to procure any, dead or alive, at any less price.

Most noticeable and best known of all the native fauna, the birds of Jamaica demand a special word. Over 200 species have been recorded, of which 40, almost exactly one fifth, are peculiar to the island. Of the remainder about 50 may be classed as West Indian, while about 90 are distinctly North American, many of our common New England birds being migrants or winter visitors. There are four or five summer visitors from the mainland of South and Central America, but they form a very insignificant part of the avifauna. Much the greater number of water-birds are more or less well known in the United States, and the same may be said of the warblers. But the doves, cuckoos, swifts, humming-birds, parrots, and fly-catchers are almost exclusively West Indian, and a large number of them are distinctively Jamaican. On the coast, besides the man-of-war birds and pelicans already mentioned, the tropic-bird occurs and terns are abundant, especially in Kingston harbour. The two common humming-birds are found in all cultivated districts; one is interesting because of its very small size, the other because of its rich, dark-purple plumage and long, forked tail. About Kingston the small palm-swift is abundant, and nests in the cocoa-nut trees in the very heart of the city. The most gorgeously coloured bird, the tody, is one of the smallest, and its bright red and vivid green plumage is very striking. The two fly-catchers, which correspond so closely to our king-bird and phoebe as easily to deceive even a careful observer, are especially common at Port Antonio, where the peculiar cuckoo, *Crotophaga*, is also always in evidence.

It is curious to note the paucity of names among the natives for even the common animals, a single name being made to serve for two or more widely different forms. The name 'sea-cat' is given to the octopus, and to large medusae, especially *Cassiopea*,

but it is also used almost indiscriminately for any unusual fish. 'Sea-squirt' is used for both ascidians and holothurians. When a native speaks of an 'owl' or a 'potoo,' it is not always possible to determine whether he means the barn owl, or the large goatsucker, *Nyctibius*, as the names are constantly interchanged. 'Rain-bird' may be a swift or one of three different kinds of cuckoo, while 'doctor-bird' and 'banana-bird' are also terms whose value depends on the speaker.

That the fauna of Jamaica is undergoing comparatively rapid changes must be clear to even a casual observer. The manatee and the agouti, as well as the iguana, are apparently on the road to extinction, and it is almost certain that the famous 'Blue Mountain duck' (*Aestrelata caribbaea*) has been exterminated during the last half of this century. The introduction of toads and the mongoose have clearly affected the land fauna, though it looks as if the native animals were adapting themselves to the new conditions. It is only a little over twenty-five years since the mongoose was introduced, and it is now common everywhere. Five or six years ago the snakes seemed to have been practically exterminated by their new enemy, but now they are beginning to appear again, so that one or two species are no longer varieties near Kingston, and we saw several near Port Antonio. Whether the snakes have developed some new form of defence or escape, or whether the mongoose has ceased to look for food in that group of reptiles, is still an open question. It is not only among the land animals, however, that such changes are going on. Several instances of remarkable changes in the abundance of a given species may be mentioned among marine animals. There seems to be very good evidence showing that the viviparous *Synapta* is becoming rarer each year, and that the area it inhabits is becoming more and more restricted. *Cassiopsea* was far from common in 1896 where it was most abundant in 1893, and we did not find large numbers of it in any one place. The remarkable little cubomedusa, *Tripedalia*, which was very abundant in the 'Slashes' in 1896 had completely disappeared in 1897, and a week of careful searching failed to disclose a single specimen anywhere in the Slashes or Lakes. It may not be safe to draw any sweeping conclusions from a few isolated facts of this sort, but they are at least worthy of note.

One cannot close an account of zoological Jamaica without some reference to the scientific work which is being done in the island itself. As an authority on Jamaican shells, Henry Vendries, Esq., of Kingston, has a world-wide reputation, and his collection of native shells is very extensive. Mr P. W. Jarvis has been an extensive collector of the crabs of Jamaica, and has furnished the United States National Museum with the types of many new

species. Mr C. B. Taylor has collected and studied birds in all parts of the island, and is beyond question the best informed man on the island in questions of ornithology. For the past nine years natural science in Jamaica has enjoyed the patronage and support in countless ways of His Excellency Sir Henry Blake, the Governor of the island, and his estimable wife. Lady Blake has painted from life the caterpillars, chrysalids and adults of many of the native Lepidoptera, and her collection of over 100 water-colours of this order are a treat to the artist as well as to the entomologist. She has also painted many of the beautifully coloured fish which abound in the Caribbean Sea, and she has contributed to scientific journals in America and England, articles on the "Aborigines of the West Indies" and kindred topics. But the scientific work in Jamaica naturally centres around the Jamaica Institute at Kingston. A handsome building, erected only a few years ago, houses a very good collection of the principal animals of the island, some of the specimens being of considerable value. At the rear of this building is a small zoological garden, which contains specimens of many of the most interesting native birds, mammals, and reptiles. There is at the Institute a very good library which is of great assistance to a working zoologist. A specialty is made of books on Jamaica. The Board of Governors of the Institute show every courtesy to visiting zoologists, and are ably seconded by the present curator of the Museum, Mr J. E. Duerden, a Dublin University man, himself a trained zoologist, whose work on the Actinaria of the island is already attracting attention. An excellent beginning has been made towards interesting the people in the natural history of their island and in making the museum the repository of a complete collection of the native fauna. In both of these aims the Institute deserves and ought to receive the assistance of every scientific visitor to the island.

HUBERT LYMAN CLARK.

AMHERST COLLEGE, MASS., U.S.A.

II

The Eskers of Ireland

OF the more recent geological phenomena none are more curious, and none have given rise to more speculation, not to say controversy, than the ridge-like accumulations, principally of sand or gravel, found throughout the midland district of Ireland.

Considering that geologists have very commonly associated these ridges—eskers as they are called in Ireland—with the products of glaciation, it appears to me not a little remarkable that they are confined to a comparatively narrow zone running through the flattest part of the island from Galway Bay to Dublin Bay. The remark would apply with almost equal force to the corresponding formations of Scotland and the Scandinavian peninsula. The kames are nearly confined to the valleys of the Clyde and Forth, as the *åsar* of Sweden have their most striking development in the Lake Mälar district. True, there are mounds of gravel in some of the northern counties of Ireland, but they are not to be confounded with the typical eskers of Galway, King's County, North Tipperary, Queen's County, Kildare, and Dublin; and in Scotland the term kame is applied to ridges and mounds "of marine, lacustrine, fluviatile, and meteoric (wind-driven) drifts."

"The centre of Ireland is chiefly a great plain of Carboniferous Limestone, partly surrounded by several groups of lofty hills composed of the oldest rocks, which rise from beneath the limestone. The hills to the south of this plain have every height up to 3000 feet above the sea. Other hills, rising to heights of 800 or 1000 feet, are composed of Coal-measures lying on the limestone; these are surrounded by valleys which are branches of the great plain. The general level of the limestone plain is from 100 to 300 feet above the sea, only a few isolated hills of limestone in the interior of the country rising to as much as 500 or 600 feet."

From this description by Jukes, it is clear that, if the surface of the country were depressed 300 feet from its present level, the waters of Galway Bay would meet those of Dublin Bay, forming a broad channel interrupted only by a few islands and occasional shallows. That such was the case during at least a portion of the period of the deposition of the limestone-gravel is generally maintained by Irish geologists; and the term 'esker sea' (Kinahan) has been used to denote the inland waters when the land depression was at or near

300 feet from the existing level. The old sea-margins are pointed to in proof of the depression—lines of beach, and notches cut into the hill-sides; but, as will appear further on, such evidence is by no means conclusive of marine action.

"The low country," continues Jukes, "is largely covered by a widely-spread mass of drift, consisting of dark sandy boulder-clay, with pebbles and blocks, and occasional beds of sand and gravel, sometimes very regularly stratified." In a footnote he adds:—"This seems to be the equivalent of the Scottish *Till*, at least in its upper part." The gravel, it may be remarked, extends throughout wide areas and to considerable depth, without any apparent mingling of clay, but consisting wholly, or almost so, of sand and pebbles. "The great majority of the pebbles are rounded fragments of Carboniferous Limestone, whence the deposit usually goes by the name of the limestone gravel. This deposit rests not only on the limestone but sweeps up on the flanks of the hills, both those that are made of the lower palaeozoic rocks and those formed of the Coal-measures. In each case the limestone gravel becomes largely mingled with detritus of the rocks of which the hills are made, and sometimes to such an extent that the local rocks assume a decided preponderance and occasionally compose almost the whole of the deposit."

That these superficial deposits were formed under the sea, Jukes entertains no doubt, just as Professor Ramsay holds that the drift of North Wales is of marine origin. Kinahan agrees with Jukes. The only ground, according to these able writers, for a contrary opinion is supplied by the unfossiliferous character of the deposits. But the circumstances would not be in favour of the preservation of shells (save those embedded in the limestone) in a mass of materials, which presumably have been subjected to much agitation and trituration. Against these, however, we have the very decided opinion of Dr James Geikie, as to the analogous order of things in Scotland:—"It seems most reasonable to conclude that neither the water-worn and stratified drift, nor the loose angular debris, nor yet the erratics that lie scattered over the low grounds of Scotland, give any indications of a former submergence of the land below the sea. The loose angular debris or moraine matter and erratics have been carried down and dropt over the terminal front of the ice-sheet, or have stranded upon the mountain-slope and hillside, or have been left lying in what once formed the bed of the old ice-sheet. The sand and gravel drifts have been produced by the action of water escaping from the melting ice-sheet which re-arranged the morainic debris, &c., heaping it up in banks or spreading it out in undulating flats" ("The Great Ice Age," p. 244 of 2nd Ed.).

Passing, for a little while, from this direct conflict of opinion, we come to discuss the particular subject now before us. For the present we accompany Jukes: "One of the most remarkable features of the upper gravelly and sandy drifts is the way in which these deposits are often heaped into mounds and ridges, which sometimes run continuously over the surface of the country. Such ridges are known as kames in Scotland, eskers in Ireland, and åsar in Sweden. These remarkable outlines are not due to mere denudation, but, as shown by the external structure of the mounds, have usually been produced at the same time as the mass of the sand and gravel was deposited.

"These mounds, in most cases, probably received their form during their first accumulation; but sometimes the surface of the drift seems to be one caused by subsequent erosion." "In one conspicuous instance (Jukes adds), two or three miles north of Parsons-town, which I visited in November 1861, in company with Mr A. B. Wynne, a widely spread expanse of deep horizontally stratified limestone gravel appears to have been so far acted upon by subsequent denudation as to have now an abruptly-undulating surface consisting of small mounds, ridges, and valleys running in various directions over a space several miles in length and one or two in breadth. One of these ridges, however, and the most conspicuous of them, forms a long esker, or narrow gently-undulating bank some fifty feet above the surrounding flat country, and some miles in length. Such eskers are very numerous in Ireland over all the low central plain. One is to be seen three or four miles to the west of Dublin, running from the banks of the Dodder, past the old castle of Tymon, by the Green Hills, towards the valley of the Liffey." Jukes mentions similar accumulations at Maryborough, Stradbally, Borrisokane, and other places.

One of the most remarkable groups (although not mentioned in particular by either Jukes or Kinahan) is situated at the western terminus of the series, just three miles to the south-east of Athenry, at St Joseph's College—locally known as 'Esker College'—formerly a Dominican priory, and so marked on the Ordnance Survey map, but lately converted into a diocesan college. The locality is called 'Esker,' just as—to the great perplexity of post-office officials—several other townlands to the west of the Shannon are so named owing to the prevalence of the drift ridges. But 'Esker, Athenry,' is distinguished among them all, no less by its history than by the gigantic character of its ridges and mounds of limestone gravel, a subject which I shall have occasion to discuss in some detail further on.

I quote again from Jukes: "The eskers are often opened for gravel pits, as may be seen in the Green Hills, near Dublin, and

the arrangement of the materials is very curious. Irregular beds of large blocks, or of small pebbles, or of the finest sand, are arranged one over the other, generally with a rude attempt at conforming to the external slopes of the ridges, but not preserving to any distance either the thickness or the inclination."

This description of the 'section,' although written with special reference to a ridge quite at the eastern extremity of the great central plain, would apply to the great esker at the College near Athenry, particularly the remarks on the stratified arrangement of the sand and gravel.

The true esker, or ridge, when seen at a little distance bears a striking resemblance to a railway embankment, and, as Kinahan remarks, is sometimes so narrow at the top that people may almost shake hands across the width. This is, however, rather exceptional. I know well the Parsonstown esker described by Jukes. It crosses the county road between Birr and Banagher—the road is, in fact, cut through 'The Ridge'; and the latter runs across the country in the direction of the Shannon, the top of it serving, for a considerable distance, as a bog-road or boreen. The Maryborough esker—also locally known as The Ridge—is said by the country people to extend "all across Ireland": it can indeed be traced, more or less continuously, for many miles. Adjoining the town of Maryborough its slopes and top have until recently been used as a cemetery. Geikie mentions certain kames in Scotland that had long been used for the same purpose.

So far we have been making approach to the interesting but perplexing question—How came these eskers to be what they are? By what particular agency, or agencies, have sand, gravel, clay, and shingle been ridged up, and at the same time sorted and stratified as we find in the typical esker?

All who have attempted the solution begin by confessing the very great difficulty of the question; and the admitted difficulty has given rise to a considerable amount of 'scientific' romancing.

"A small mound quite close to Dunfermline is locally famous under the name Mont Dieu. According to an old story this drift mound owes its origin to some unfortunate monks, who, by way of penance, once carried the sand in baskets from the sea-shore at Inverkeithing" (J. Geikie, "Great Ice Age," p. 212). And there is a similar legend as to the origin of a mound in the valley of the Kali Water, Roxburghshire. From the economical point of view these cases are very good examples of 'unproductive' labour. But, from the inquirer's point of view, they are hardly more romantic than the explanation put forth, in the cause of science, by Mr A. E. Törnebohm as to the origin of the Swedish åsar or eskers.

His belief is that the åsar are ancient river courses, and he

points to their river-like ramifications. In the valleys containing these ásar, detached patches of sand are sometimes found—the wreck, he believes, of a great deposit of sand. In such a deposit, rivers would soon cut down a deep channel. In the bottom of this channel pebbles and gravel would collect, then gravel, or sand, or mud layers. In time, the course of the river is diverted, the adjacent sands wear rapidly away, and the more compacted deposits of the river-bed longer resist denuding influences, and in the end stand out in bold relief as ásar or eskers.

One can hardly forbear exclaiming—Too clever by half! The author uses, to the full, the romancist's privileges. He has everything he requires at hand and in abundance, and what he no longer requires he gets rid of with the readiness of a necromancer. Rivers have, no doubt, often struck out new lines of action for themselves. But here everything makes its bow and retires just when it has acted its part.

THOMAS FITZPATRICK.

ST IGNATIUS' COLLEGE,
GALWAY.

(To be continued.)

III

The Chemistry of the Forest Leaf

THE fundamental feature of a leaf is, as everybody knows, the presence therein of a body called chlorophyll, which is defined as "the substance, or maybe a mixture of substances, to which the pure green colour of ordinary healthy leaves and of other vegetable organs is due." Here our attention is at once arrested. Is it possible that no competent and expert chemist can be found who will proclaim with absolute confidence and assurance that chlorophyll is a single substance, or that it is a mixture of substances? So far as I can find, the original investigator of chlorophyll was Morot, and he gave a hypothetical formula for it, but said it was always accompanied by a fatty substance which he regarded as the chromogen thereof. In 1860 Fremy showed that the green matter was a simple mixture of two bodies, viz. a blue (phyllocyanin) and a yellow (phylloxanthin) existing side by side; whereas Pringsheim and others held that these were merely decomposition products of an originally single chemical individual. On the other hand, Dr Sorby considered the existence of a chlorophyll, a phyllocyanin, or a phylloxanthin of a definite chemical composition to be improbable. Meanwhile, an examination of the foliar organs of various species among the great vegetable groups and classes led Gautier in 1866 and later to conclude that chlorophyll differs among these—nay, even in various species of the same genus it may be dissimilar. But the crowning consummation of all previous researches seems to have been reached in 1895 when Mr Etard, in a memoir read before the French Academy, declared that a given species of plant may contain several chlorophylls, *e.g.* he describes four distinct, perfectly defined ones as occurring in Lucerne. "It may be concluded," he states, "that the green matters of leaves contain a very stable fundamental nucleus carrying the function of optical absorption in connection with a biological process; and around this nucleus, this trophic point, can be fixed, in a way more or less permanent according to the needs of nutrition, different chemical groupings giving place to chlorophylls different in their composition, their molecular weight, their solubilities, their isomers, and the rôle which they may play in the living species." "The operations of vegetable synthesis leading at the same time to fatty bodies insoluble in water and to matters eminently soluble, always by the intermedium of absorptive green matters, it is natural to think that one and the same chlorophyll would not be sufficient for the work" (*Comptes Rendus*, vol. cxx., p. 328).

Now, although Mr Etard has, by virtue of masterly analytical skill, succeeded in separating certain distinct green bodies occurring in the same species, which seem to respond to a definite chemical composition, it is not so clear that the question as to what chlorophyll itself really is has been finally settled. The grand difficulty is to decide definitely whether chlorophyll is (like carotin) a solid substance in itself and present in such quantity as to allow of its being separated and withdrawn purely and simply from the other constituents of the leaf; or whether it exists therein in exceedingly minute quantity only (like that of a dye fixed on a vegetable fibre), and inseparable therefrom save by means which bleach and destroy it irrevocably? It is evident that if the former alternative be accepted, then by simply absorbing the green pigment by animal charcoal from the 'chlorophyll,' it will still retain its physical and chemical characters unchanged; if the latter be adopted, the same absorption will completely destroy only the colouring matter as such.

Unfortunately it is absolutely impossible to tackle the question on these grounds or in this fashion, for the simple reason that no solvent at present known extracts chlorophyll, *i.e.* the pigment, purely and solely from the leaf; it is invariably conjoined with fats, waxes, resins, etc., and even subsequent exhaustive treatment with a series of different solvents does not eventually effect a complete purification. Such being the case, we must rest content with the results and effects of close application and a prolonged experience, feeling assured that in the course of time views and vistas will open, leading to a correct apprehension of the subject. One of these views may now be exploited for the edification of the reader.

Microscopic observation of the living leaf reveals that the chlorophyll granules are individually independent globules of dense protoplasm without proper walls plunged in the midst of the fundamental protoplasm and tinged by the green matter, their form and size remaining unaltered when extracted by ether, etc. Protoplasm itself is of course insoluble in the solvents which readily dissolve chlorophyll, but it is always accompanied by fatty matter of free formation which doubtless is one of the products of assimilation. Starch also, although not invariably present, very commonly occurs in these corpuscles; and Belzung seems to think that its presence is necessary for the formation of the green pigment—an opinion which I am disposed to dispute. In addition, however, to starch and fat, the occurrence of which is sufficiently palpable, it would be absurd to imagine that other bodies are not evolved in quantities more or less minute during the career of the tremendous vital energy exerted by the living protoplasm. Tremendous certainly it must be at the actual moment of its outcome, but perhaps for that very reason essentially frail and subject to degradation and decay. Hence arise

the well-known and characteristic decomposition products, normal or putrefactive, one of which, to take an example, indoxyl-sulphate of potassium (present in human urine) is easily oxidised to the powerful pigment indigo. In 1873 Bommer showed that some very small colourless granules scattered on the protoplasm of the flowers of *Phajus maculatus* readily produce indigo when the oxygen of the air comes in contact with the cell-contents; and according to him the experiments of Fremy fully suffice to prove that the origin of blue chlorophyll (phyllocyanin) is due to the presence of indican transformed into indigo, which exists in chlorophyll though in excessively minute proportion. We may observe that it is just this extreme minuteness which forbids probably for ever the precise determination of the chlorophyllian chromogen. We do not know what its chemical constitution is, or whether it is a real dye-stuff with a function either basic or acidic (I believe it is the latter). It has been maintained that chlorophyll is not a substance derived from an open chain of carbon atoms, and that very probably it is a derivative of a benzenoid hydrocarbon; but I think it is more probably a derivative of polyuric or acrylic acid. The difficulties attending the discovery of its real origin and chemical relationships seem to spring from the fact that its outcome and presence in the leaf do not depend on the aërial oxidation incident to an expanded cellular surface, still less on transpiration, but are solely and absolutely the direct and immediate result of the life energy whose existence is indissolubly interwoven with the protoplasmic stroma of the chlorophyll granule.

A. Baeyer suggested that in the dissociation of carbonic acid, or of water, protoplasm is at the bottom of the whole business, and that chlorophyll plays only some subsidiary and indirect part, such as that of temporarily fixing carbon dioxide as does haemoglobin, and so facilitating the dissociation. According to Engelmann, while the chlorophyll granules give off oxygen in the light, colourless protoplasm, cell membrane, and nucleus do not; the green pigment itself is not capable of so acting, it must be present in connection with the living stroma of the chlorophyll granule. Timiriazeff held that the function of chlorophyll is to absorb the rays which possess the greatest energy, being transparent for those rays, and to transmit this energy to the molecules of the carbon dioxide, which would not of themselves undergo decomposition; while Mr Berthelot has shown that the presence of inert gases, such as nitrogen in the air, determines the phenomenon of the dissociation, they having the effect of separating the atoms of the carbon dioxide, acting thus on the active gas as a diminution of pressure would do. Nevertheless, and although all these physical and mechanical agencies may aid and abet, the question is, are they really and truly the practically determinant or dominant causes of the effect? It seems to be tolerably certain

that colourless protoplasm is quite competent to effect the dissociation in question (*i.e.* if such ever actually does come to pass), provided always that its forces are sufficiently concentrated and its position favourable. It is known that the protoplasm of the chlorophyll bodies is, like that of the nucleus, denser than the cytoplasm, and this increase of density is doubtless associated with an augmentation of vital energy and activity. Then why may not the nucleus with all its superior density likewise achieve the decomposition of carbon dioxide? Because its composition is utterly different from that of the cytoplasm; its function is to generate not special matters, but special motions; it excites the activity of the cytoplasm, but is not indispensable for metabolism; it is no part of its business to decompose gases or liquids; in fact, according to Preyer and Windt, it merely regulates the progress of the assimilation and de-assimilation of the protoplasm. In this connection it may suffice to merely mention the amyloplasts of Schimper, the leucoplasts of Sachs, and the free formation of starch without the intervention of chlorophyll, or even of leucites demonstrated by Belzung.

If we profoundly consider the matters herein and just now set forth, we can hardly resist the conclusion that chlorophyll, *i.e.* the simple pigmentary substance, is not truly the cause or indispensable auxiliary of the assimilative energy of the protoplasm of the leaf, but rather it is one of the direct and immediate consequences of the vital activity thereof. Whatever increases and heightens the vital activity increases at the same time and *pari passu* the amount of chlorophyll. The peculiar and characteristic feature in connection therewith is that it is not really a waste-product, or an excretion in any sense, or a product of de-assimilation; it is a specific consequence of the specific life activity interwoven with a protoplasmic substratum, whose molecules dissociate but do not degrade. Living protoplasm has an active power of respiration, and the greening of etiolated leaves grown in the dark is, when they are exposed to light, for and by itself no assimilation process, and it takes place without decomposition of carbon dioxide. The pigment itself is almost certainly a dark dull blue substance, such as can be isolated from Gramineae more especially, and the mixture thereof with the brilliant and stable yellow carotin, which all leaves contain, affords the greenery, and at the same time vivifies and, as it were, burnishes it.

If Mr Etard's conclusions that a given species of plant may contain several kinds of chlorophyll be provisionally accepted, it is indispensable that the term 'chlorophyll' should mean not the pure pigment only, but the entire waste or excretion ensuing from the chemical processes undergone in the protoplasm of the chloroplastids. His researches furnish a twofold basis. "It is the chlorophylls," he states, "that are insoluble in pentane, which tend on splitting up to

produce carbohydrates, tannins, and extracts; those that are soluble in pentane tend to produce essences and oils." Hence supposing that these two chlorophylls exist in different or varying proportions in different species of plants, and practical analysis proves that they do so, then we have a satisfactory explanation of the fact that some plants are oil-producing, while others are starch-producing. It is well known that the leaves of various species differ enormously in their capacity for forming starch, and trees have actually been classified by Fischer and Suroz into 'Fettbäume' and 'Stärkbäume.'

There is, however, another view of the matter, viz., that propounded by Mr Mesnard, according to which, while the free fat oil, carbohydrates, and the reserve albuminoids are products of assimilation, the tannoid compounds, essences, resins, and tannin are products of de-assimilation. All are products of chlorophyll, and all constitute materials for the latex; but the immediate origin of the fixed oil is, if this version be correct, not the same as the immediate origin of the essential oil; whereas, according to Mr Etard, both of these plant constituents proceed from the same kind of 'chlorophyll.' It is hardly necessary to mention that the original doctrine formulated by Wiesner, and upheld by Fluckiger and Tschirsh and by many other German chemists and physiologists, was that the essential oils and resins are formed at the expense of starch or even of cellulose, that in fact the resins and ethereal oils are the final products of a series which begins with starch or glucose, and passes through tannin as an intermediary (Franchimont had, however, contested this as to resin); but according to Mr Mesnard the substances in question proceed from the transformation of the tannoid compounds produced by chlorophyll. "The formation of the essential oil," he states, "is very rapid, and is effected in a fashion almost immediate, while that of the tannins and pigments requires a long exposure to light and air."

Thus it will be seen that while many investigators, with some honourable exceptions, were fumbling and bungling over the subject, and allowing themselves to be misled and distracted by fanciful formulas and mystical alchemy, the true scientific ideas and experiments of a single Frenchman (with whom, however, Mr Blondel may be associated) have thrown a powerful search-ray of light over the hitherto dark and troubled waters. Personally I never could swallow the doctrine that the tannins were derivatives of the carbohydrates; and notwithstanding Waage's elaborate formulary to prove that phloroglucin is formed as the result of the splitting up of glucose, I am more disposed to accept Nickel's view that it may be formed by the withdrawal of water from inosite—a body whose reactions seem to connect it to some extent with the proteids or albuminoids. I am convinced that, save and except the processes connected directly with assimilation, the other subsidiary and supplementary chemical

operations which take place in the leaf are of a comparatively simple character. Before, however, we proceed further, it will be advisable and indeed highly requisite to provide a table after Mesnard (slightly altered):—

Products of assimilation.	Products of de-assimilation.
Free fatty oil.	Tannoid compounds (rutin, etc.).
Carbohydrates (starch, glucose, etc.).	Resins, balsams, and essential oils.
Albuminoid matters of reserve.	Tannins.
	Coloured pigments.

It would be superfluous to adduce facts as bases for arguments to prove that the sketch here set forth is a positive and veritable representation of what actually comes to pass in the chemistry of the living foliar organ. No one disputes that fats, carbohydrates, and albuminoids are direct products of assimilation. The fat oil is deposited in the cells without there being a simultaneous deposit of albuminoid matters; but that there is some close connection between the oil and the starch and sugar is evident (though only provisionally and superficially) from the respective distribution of these bodies in the plant tissues. Thus the oil of the ripe seed is, according to Sachs, produced from the starch and sugar transported from the primary stem. The storing up of oil occurs in all the amylaceous tissues. In the autumn the starch contained in the branches of our forest trees is gradually 'transformed' into oil, and in the spring this oil is again 'transformed' into starch and sugar. The cells of the leaf which are free from oil are also free from starch. On the other hand, the fact that oil occurs stored up in the cells of the perisperms or of the cotyledons of certain seeds in Cruciferae, poppies, flax, almonds, etc., in which little or no starch is produced, would seem to show that oil and starch are more or less independent of each other. "In all cases," says Mr Mesnard, "the fatty oil is independent of the starch and the glucose, even in the rare cases of grass seeds where the oil is specially localised." I think it by no means follows because, as in the winter boughs of our forest trees, the oil steps into the place of the vanishing starch, and *vice versa* in the spring, that therefore one of these bodies is unquestionably derived from, transmuted into, or even formed at the expense of the other. Protoplasmic activity specifically directed is amply capable of creating or of destroying one or the other constituent independently and in accordance with the contemporary needs of the organism. Possibly may it not be that the winter production of oil is associated with low vitality, while the summer production of starch is associated with a high vitality? With regard to the organic acids of the leaf, I adhere to the views of Dehérain and others that they are oxidation products of the carbo-hydrates, and have got nothing to do with the synthesis of the proteids.

With reference to the scheme of the products of de-assimilation exhibited on the right-hand side of the aforesaid table, it may be observed that a considerable experience in plant analysis is requisite in order to appreciate it thoroughly. Suppose, for instance, that we are determined to engage in a complete study of the chemistry of the forest leaf, we must commence with the earliest growth of the organ—in fact, we should commence with the winter buds, but at any rate we examine the young leaves just unfolded, and we, by appropriate methods of analysis, discover that one body seems almost universally present in them all, and that body is a tannoid compound (rutin or quercitrin). It is inevitably present because it is the first formed product of the chlorophyll (*i.e.* the proteid) substance that has spent its energy, and lies in the position of a waste or excrementum. But what then ensues?

The leaf progresses in growth. Oxidation more or less complete supervenes on every item of its tissues and contents which is not directly under the dominion of the reducing energy of the living and vigorous protoplasm. The tannoid compound aforesaid is gradually transformed more or less completely into volatile oil and resin, or into tannin, but until the late autumn the change into the latter body is probably never entirely and absolutely accomplished. Practically in the majority of our forest trees there is no formation of essential oil in the leaves, but there is always apparently a residuary resinous body or a 'bitter principle' extracted by benzene or alcohol, and there is invariably tannin, the quantity of which increases from spring till autumn, reaching its maximum about October or November. According to Kraus, there is generally twice as much in the October leaves as there is in the June leaves. That some such progressive change ensues as is here described, even supposing that a portion of the material formed is daily conducted away into the bark and wood, there can be no doubt whatever.

On the whole, therefore, it may be admitted as established that, while the forest leaf is *par excellence* an organ of reduction so far as its purely and distinctively protoplasmic energy is concerned, yet at the same time very considerable and important oxidising processes take place among the lifeless ruins, so to speak, of its spent and exhausted activities. The bye-products, the waste of protein bodies are only partially and slowly excreted and cast off, an expulsion which dies gradually away in the old age and decrepitude of the organ when autumn comes upon the scene, and the reducing agencies of the protoplasm having been expended, the oxidising agencies of light and air enjoy unrestricted sway crowned by the golden and crimson glories of the autumn woodlands.

P. Q. KEEGAN.

IV

The Species, the Sex, and the Individual¹

IN investigating the evolution of animal structure we have to consider not merely the features which distinguish species and groups of species from one another, but the difference between distinct types within the same species, and the changes which the individual passes through in the course of its life. The selection doctrine is held by its adherents to afford an explanation of the facts in all three of these divisions, but no one has hitherto pointed out the close similarity between the phenomena in the three cases, and attempted to prove that the principles he adopts are really applicable in detail to all of them. Examples of the differences of structure by which animals are classified are familiar to every one; the remarkable differences between male and female in the same species of bird, such as the peacock or pheasant, illustrate the second class of facts; and the differences between the tadpole and the frog, the caterpillar and the butterfly, illustrate the third.

Selection in nature can only mean the survival of an individual by virtue of some useful peculiarity in its structure, and selection as a theory of evolution can only be applicable to structural features which are of some use to the individual, enabling it either to obtain food or shelter, to escape enemies and natural dangers, or to reproduce its kind. Hence if the selection doctrine is true, everything in the structure of animals must be adapted to some useful end, must be an adaptation—or it must be the physiological corollary of an adaptive structure, must be correlated with some useful variation.

¹ With reference to this paper, Mr Cunningham has given us the following information, which we have verified. The paper was written at the beginning of 1897, and after some time was submitted to the Zoological Society, but not accepted, even for reading, on the ground that the Society did not usually publish papers of a theoretical and controversial character. The manuscript was then sent to the Linnean Society, where it was read on May 6th of the present year, and a brief description of it was published in the report of the meeting in the *Athenæum* and in *Nature*. But this Society also refused to publish the complete paper, the alleged reason being the pressure of other papers and illustrations. It is due to Mr Cunningham that these facts should be known, for on June 7th, 1898, there was read before the Zoological Society a paper by Mr L. W. Wigglesworth, containing conclusions as to sexual dimorphism very similar to those of the present paper. In particular, as the published abstracts show, the author maintained that secondary sexual characters in birds were due to the stimulation of parts through use, or external violence, or irritation.

So much for Mr Cunningham's title to priority. As for the refusal to publish his paper, we understand that the Zoological Society has equally refused that favour to Mr Wigglesworth, although he was more fortunate in having his views placed before a meeting, and published in abstract. There is a general feeling among those who hold views opposed to the current strictly Darwinian notions that they cannot get fair play from our learned societies. It is a pity that they should be able to adduce so many facts in support of this opinion, however erroneous the opinion itself may be.—*Ed., NAT. SC. I.*

The conception of correlation means that, owing to something in the constitution of the animal, two or more features can only vary together in certain directions, for example it might be found that a dog could not have less hair without having smaller teeth, and the advantage of larger teeth might in such case be alleged as sufficient explanation of long or thick hair.

It is of course not necessary to the selection argument that all characters should be useful at the present day. They might have been evolved in a former period when they were useful under other conditions, and be still inherited after they have ceased to be useful.

However, the more we study the forms and structure of animals the more difficult we find it is to believe that all peculiarities by which the various species are classified are to be explained directly or indirectly by adaptation. We may study the question in reference to the characters distinguishing subdivisions of any degree, but it has been most discussed in reference to the peculiarities of species, and these can only be studied in actual examples.

The case with which I am most familiar is that of the flat-fishes.

The plaice, flounder, and dab, are three species of the same genus, whose habits and life-histories are fairly well known, and whose structural peculiarities have been minutely investigated. The dab is principally characterised by the presence of well-developed ctenoid or spinulated scales all over both sides of the body, and by a semicircular curve of the lateral line above the pectoral fin.

In the plaice we see conspicuous red spots; the scales are for the most part smooth, cycloid and reduced, the lateral line is straight, and the bony ridge behind the eyes is elevated into five tubercles.

In the flounder we find another condition of the scales: some are smooth and reduced in size as in the plaice, while others are enlarged and developed beyond the condition seen in the dab. Along the bases of the marginal fins there is a series of these enlarged scales, which form thorny tubercles; and there are others along the lateral line. Other peculiarities are the smooth ridge behind the eyes, and the small number of the fin-rays.

In other respects these fish are much alike. There are differences in their habits and life histories. The flounder lives in estuaries and rivers, only descending to the sea in the spawning season. The plaice and dab are almost invariably found together. The plaice feeds mostly on molluscs, the dab chiefly on crustaceans, worms and echinoderms. The young plaice congregate near shore, while young dabs are found at various depths. The plaice begins to spawn earlier in the year than the dab.

Now it is quite impossible, at any rate up to the present time, to find the slightest indication that the specific characters of these three species are useful in relation to these slight differences of life-history.

We cannot find that the rough tubercles of the flounder are useful to it because it lives in rivers or for any other reason, we know of no advantage which the plaice derives from its red spots, its smooth scales, or the bony tubercles on its head. Nor can we find any indication that these peculiarities are correlated with adaptive differences. The only adaptive difference at present clear is that the plaice has blunter teeth in its throat than the other species, and that these are suitable for crushing the shells of the bivalves on which the plaice feeds. But we know of no connection between this and the other characters. The theory then that these specific peculiarities are due to the natural selection of indefinite variations is unsupported by any evidence.

How then are we to explain such specific characters? It seems to me we are forced to regard them as the necessary consequences of growth and of the conditions of life. It is evident enough that differences of habit and the extension of a species into different regions will necessarily lead to its subdivision into groups between which little or no interbreeding takes place. The individuals which lived in estuaries would breed together and not with those that lived always in the sea. Thus any modification produced in the one group would remain confined to that group, and by interbreeding within that group would be kept approximately uniform. It is difficult in the present state of our knowledge to say how modifications of the kinds here in question are determined. There are indications that continuous modification takes place in successive generations without any direct stimulus that can be detected. We must remember that the development of the individual is the growth and multiplication of groups of differentiated cells. This development is controlled partly by heredity, partly by surrounding conditions, but the development of every part and every organ is to some extent independent. The facts indicate that a particular part or organ may for some unknown reason obtain increased nourishment and develop with increased vigour, or on the other hand may show diminished vigour, and that the change may be progressive in successive generations. It would seem that ultimately the effect must be due to external conditions acting upon the properties of living matter. But the action is evidently very indirect, and the processes involved are so complicated and recondite that at present we know nothing about them. We have indications of the influence of external conditions in the differences in the same species in different geographical areas. Thus the flounder in the Mediterranean has scarcely any tubercles, while in the Baltic and Arctic regions those structures are excessively developed, so that nearly the whole skin is covered with them. Whether this is due to the cold or not we do not know, but it is a fact that the plaice also shows greater roughness of

the scales in the north than in the south. The difficulty is that this effect of northern latitudes is not observed in the fishes of other families, and we have to face the problem how it is that the same change of conditions produces different effects in different cases. It is possible, however, to investigate the subject by analysis and experiment. The point on which I wish to insist here is that specific characters are intelligible when regarded as the necessary consequences of the conditions of life, while the supposition that they are of any use or significance in the struggle for existence is in a vast number of cases unsupported by any evidence.

Having thus indicated the reasons for rejecting the conclusion that all distinguishing characters are adaptive or advantageous, we may proceed to consider the origin of adaptations.

It may be truly said that no animal is without adaptations; it must be provided with some means by which the essentials of life are secured, but these means may be exceedingly simple or exceedingly complex. But there is another idea implied in the conception or adaptation, the idea of unity in diversity, of parts essentially similar being modified in different animals for different purposes, being adapted in many cases for purposes quite different from that which they originally served, as in the case of the fore-leg becoming in birds the wing. It is possible to trace such modifications and more or less disguised homologies without any reference to the doctrine of evolution. The principle of descent with modification gives the explanation of the phenomenon. The unity of plan is due to heredity; the divergence, to adaptation to changed conditions. But we must pursue the investigation further, and endeavour to discover how the modification is effected. It may be asked, since we admit that adaptation is such a prevalent phenomenon in the animal kingdom, even if it is not universal and exclusive, what other explanation of it is required than natural selection? In reply to this I would urge, in the first place, that natural selection implies and assumes the appearance of variations, of slight modifications by virtue of which certain individuals differ from their brethren and from their parents, in fact from all pre-existing individuals. The real explanation of evolution therefore lies in the explanation of individual variations. We admit that they occur, but how and why?

Darwin held that the use or disuse of organs and the direct action of conditions caused modifications of individuals in definite directions, and that these modifications were hereditary in some degree. Now, if once we admit this, selection becomes a secondary and subordinate factor. For if a new set of conditions or a change of habits caused a hereditary change of structure in all the individuals exposed to it, continuous modification would take place even if all the individuals generated survived, or if those which were

killed were taken at random without selection. Thus Darwin's system contained its own refutation within itself. A later school of evolutionists have maintained that the effects of habits or conditions on the individual are not inherited, and therefore not cumulative. According to this view, only those variations are hereditary which arise in the germ, in the internal constitution of the egg; such variations are supposed to be numerous and to take place in all possible directions, and natural selection is supposed to pick out from among them those which are advantageous and so accumulate them. I do not propose here to discuss the various theories of heredity. The question of the possibility of the transmission of acquired characters, or the determination of congenital modifications by the direct influence of conditions is a very important one, and has been much discussed. But I wish to draw attention to a mode of considering the subject which is generally neglected, namely, the inductive method. The doctrine of evolution is an induction from the facts of zoology; in my opinion conclusions concerning the method and the causes of evolution can also be obtained as inductions from a sufficiently wide survey of the phenomena.

Every one will admit without hesitation that all variations must be due to causes. But, according to the selectionists, hereditary variations have no primary and essential relation to the requirements of life. Such variations occur in all or many directions indefinitely, and they are so diverse that by the survival of a few individuals out of the many that are generated, the complicated adaptations which we know have been gradually produced. It is as though we conceived of a table being produced by the process of selecting from a large stock of pieces of wood of all shapes and sizes, those which were of the shape and size required, and joining them together; and not by the usual process of sawing and planing the various parts into shape out of a stock of planks all originally similar. Thus selection preserves and combines the variations which are most advantageous under the given conditions, but the relation between the structure and the outer world has no hereditary effect in moulding or shaping the structure. Romanes maintained with much truth that natural selection was a theory only of the origin of adaptations, and not necessarily of the origin of species, but it is further necessary to realise that it originates adaptations only in the sense of preserving and combining the variations or modifications which occur, and which happen to be advantageous. It may be said to combine only in the sense of causing different variations in the parents to be transmitted together to the offspring, and of allowing new variations to occur only in the individuals which have survived.

Now it is possible by actual observation to ascertain what evidence there is, that variations which might by natural selection

be combined into the adaptations we see, do occur apart from the special habits or conditions to which the adaptations are related. The variations that occur constantly in the form of individual differences, have been minutely investigated in the past few years by statistical methods, with the aid of the higher mathematics. The greater the difference, the more rarely it occurs; and occasionally striking abnormalities are observed, the character of which points to definite principles of symmetry and repetition in development. But it is not proved that, without change of conditions, variations occur which could by selection give rise to such special adaptations as abound in the animal kingdom. For example, the power of partial or complete flight by means of a membranous fold of skin, has been evolved in many independent cases in the vertebrate sub-kingdom, in the extinct pterodactyl reptiles, in bats, in flying foxes, flying squirrels, etc. But the variations in the condition of the skin and limbs in animals that do not fly or take long leaps through the air, are not such as to justify the belief that by the mere selection of the maxima among such variations, a membranous organ of flight could be evolved. To take another instance, there is a fish which has its eyes in a very remarkable condition. Spectacles for our own eyes, for human eyes, are sometimes made in which the upper half has a curvature different from that of the lower. The fish to which I refer, *Anableps*, does not wear spectacles, but actually has its eyes made in two parts, in the upper part of which the lens has a different curvature from that of the lower. The pupil is also divided into two by prolongations from the iris. This fish is in the habit of swimming at the surface with its eyes half out of the water, and the upper half of the eye is adapted for vision in air, the lower half for vision under water. Now, however various the individual variations in fishes' eyes, there is no evidence that variations which could by selection give rise to this curious condition, occur in other species of fish. It seems to me that we have no reason to suppose that the required variations ever occurred, until the ancestors of *Anableps* took to swimming with their eyes half out of the water. A similar argument applies to many other cases of special adaptation, and the logical conclusion is that the habits and conditions determined the modification.

On the other hand, it may be asked, what positive evidence have we that special habits or conditions do determine special modifications. The reply is, that we have abundant and admitted evidence as to the effect on the individual; and as hereditary modifications are, in many cases, of the same kind as these, the presumption is, that the effect on the individual has become hereditary. The question, however, of the origin and causes of adaptations cannot be considered apart from the phenomena of development and individual

metamorphosis to which I shall refer further on. At present I will pass on to the consideration of the second class of structural differences, those which distinguish constant forms within one species.

The commonest and most widely extended case of this is the existence of what are called secondary sexual characters, in other words the existence of structural differences between males and females in addition to the primary and essential differences in the generative organs. Darwin explained these differences by another kind of selective process, namely sexual selection. He pointed out that there is competition in courtship as well as in the struggle for existence, that the successful males are those which conquer their rivals by force, or which please the females best by their beauty of appearance or melodiousness of song. Now whether this is true or not, and there is certainly a great deal of truth in it, it is not sufficient to explain all the facts. In the first place it does not explain why the peculiarities of males do not begin to develop until the generative organs become functionally mature. If selection by the female were the principal factor, an earlier development would be an advantage. A male bird, for example, that already had its special plumage fully developed when he first became mature, would defeat those in which it had only just begun to develop, and consequently early development of the special plumage would soon become universal. The only way to meet this objection is to maintain that the young males find an advantage in being inconspicuous like the females, because they thereby escape their enemies, or that they obtain some other benefit in the struggle for existence by the retardation of the development of their secondary sexual characters. But when we study the matter without prejudice we find that the sexual peculiarities are associated with special habits and conditions, which do not come into force until maturity is attained, and we have reason to infer that the necessary modifications only occurred in connection with these habits and conditions.

As it is usually the male bird which is stronger, more active, and more adorned, some biologists have concluded that the whole constitution of the male is naturally more inclined to active physiological changes, that of the female more to simple vegetative growth. But there are plenty of cases to show that no secondary characters are invariably associated with the male sex rather than with the female; the evidence indicates that the characters are related to particular conditions and habits. In some species the usual differences between the sexes are reversed, the male is inconspicuous and resembles the young female, while the adult female has peculiar characters. In these species we find that the usual habits are also reversed.

Every one knows that there are enormous differences among different species in the degree of development of secondary sexual characters. In many cases there are no such characters, the males and females are similar; and in these cases not only are sexual differences wanting, but we do not find variations which if increased would lead to them. Secondary sexual characters in the plumage and in other structures are very conspicuous in the Class of birds, but there are numerous species of birds in which the male and female are scarcely distinguishable. It is an important fact that in the latter cases the birds are monogamous, pairing either for a whole season or for life, while birds in which the male plumage is in gorgeous contrast to that of the female are frequently polygamous. This fact has been emphasised by Darwin, but the significance of it in his view was that polygamy involved a relative excess in the number of males, so that those which obtain a plurality of wives have been selected from a large number, leaving a remnant which obtain no wives at all. I believe that the correct interpretation of the matter is very different.

It is well known that, in the most familiar cases of special plumage in male birds, this plumage is elaborately displayed in courtship in a definite manner peculiar to each species. As Darwin states, "Ornaments of all kinds, whether permanently or temporarily gained, are sedulously displayed by the males, and apparently serve to attract or fascinate the females." Now this display is an erection of the feathers by the muscles in the skin, and a movement, an agitation or vibration, of the feathers. We have every reason to believe that a mechanical movement of the feathers must irritate the papillae from which they are produced, and stimulate the proliferation of epidermis to which the growth of the feathers is due. Thus, if we consider only the increased size of the feathers apart from their colour or markings, we may conclude that the display and erection of certain feathers is the exciting cause of their excessive development in the males. This theory is supported at any rate by the fact that the degree of development of special plumage corresponds to the proportion of his life and activities which the male devotes to courtship. This may, in the present tendency of biological doctrines, be considered absurd, but it will be found, if the facts are examined, that it is literally and scientifically true. The pigeon, for example, pairs for life. He performs gestures of courtship it is true, but he also takes an equal share with the female in the duties of incubation and care of the young, and consequently his courtship consumes only a small portion of his time. A polygamous male bird on the other hand performs no part of the work of incubation or feeding the young, and in the breeding season spends a very large part of his time in displaying his plumage to his numerous partners.

In no family of birds are the males more gorgeous or more different from the females than in the Birds of Paradise. Darwin says in his treatise on Descent of Man and Sexual Selection that, according to Lesson, these birds are polygamous, but that Mr Wallace doubts it. The sexual selection therefore is to this extent less probable or less severe, but there is no doubt whatever about the difference of habits to which I attribute the difference of plumage between the sexes. In another passage in the same book Darwin writes: "With Birds of Paradise a dozen or more full-plumaged males congregate in a tree to hold a dancing party as it is called by the natives, and here they fly about, raise their wings, elevate their exquisite plumes, and make them vibrate, and the whole tree seems filled with waving plumes."

It may be objected that the mechanical stimulation which I have adduced as the cause of the hypertrophy of the feathers, will not explain their brilliant colouring or the beauty and symmetry of their markings. To which I would reply that stimulation of the growth probably causes also a more intense production of pigment; that symmetry of marking is a universal character in organic growth throughout the animal kingdom; and, thirdly, that very possibly the different qualities of the light to which males and females are exposed have something to do with the dull colours of the female which sits close with her young in obscure retreats, and the bright colours of the male which keeps more in the open.

I have already referred to the fact that in some species the relative characters of the sexes are reversed, and it is the females which are larger, more pugnacious, and more elaborately adorned than the males. Darwin, of course, attributes this to the reversal of sexual selection, but it seems to me more rational to hold that the differences are not merely selected but called into existence by the habits and conditions. In these cases the male alone performs the duties of incubation and nursing, and the female takes all the initiative in courtship. Here, as in the males in the usual case, the peculiarities of the female only begin to develop when she is approaching maturity, the young of both sexes being similar to the adult male. Species of *Turnix* in India and Australia are instances of this condition.

J. T. CUNNINGHAM.

I MORRAB TERRACE,
PENZANCE.

(To be continued.)

V

The Delimitation of the Albian and Cenomanian in France

THE nomenclature of the English Cretaceous System is based upon the lithological differences exhibited by its members, the only division which from the beginning had a name of different origin being the Wealden. Such a basis of nomenclature is bad because lithological differences are local or provincial accidents.

French geologists have often expressed surprise at the conservatism of Englishmen in retaining a nomenclature which only perpetuates errors and cannot be made to express the true relations of the component parts of the Cretaceous System. They are quite right: it has perpetuated the error that the Gault as a whole is older than the Upper Greensand as a whole, and has prevented us from recognising long ago that they were to a large extent merely different lithological facies of one formation.

There can be no question that the distribution of species affords a better basis of grouping than the lithological characters of deposits. Put in this way it seems a truism, but it is nevertheless a fact that our existing system of nomenclature ignores this principle, and does actually separate deposits which ought to be grouped together; while it suggests a connection between 'Lower' and 'Upper' Greensand which has no existence in reality.

The French method of nomenclature is free from this reproach, and it has been preferred to our own by most other European nations. The French completely ignore lithological differences, and their subdivisions or stages include all deposits which yield a similar assemblage of fossils.

D'Orbigny says that his principal object in undertaking the "*Paléontologie Française*" was the application of palaeontology to the natural classification of the formations, and it is to him that the French owe their nomenclature of the Jurassic and Cretaceous systems. He found that of the Cretaceous system in dire confusion, but when he had examined 593 species of Cretaceous Cephalopoda and Gasteropoda he felt himself justified in dividing the whole system into five distinct stages, each containing a special fauna. This was in 1843, and, abandoning the lithological names which were then current in France, he proposed new names for his stages, taken from those of towns or districts where each stage was well developed and specially fossiliferous. These five stages were Senonian, Turonian, Albian, Aptian and Néocomian. In 1852 he added a sixth, having recognised that the group which he called Turonian in 1843, really comprised two stages with essentially differ-

ent faunas; consequently he restricted the name Turonian to the upper of these stages, and gave the name of Cenomanian to the lower.

Since 1852 these names have always been used by French geologists, but in spite of much careful work on the fossils, and in spite of the progress made in stratigraphical geology, the delimitation of these stages has never been satisfactorily settled. The restriction of the fossil species to the several stages did not prove so complete and exact as had originally been supposed. Many species were found to range from one stage to another, and where there is a gradual passage from stage to stage, there is of course scope for difference of opinion regarding the plane of separation. Moreover in the case of the Albian and Cenomanian there are special difficulties, for in the Aube whence was taken the type of the Albian, the fossiliferous beds corresponding to the Lower Gault are overlaid by a great series of almost unfossiliferous marls (representing Upper Gault), and the Cenomanian is neither well developed nor very fossiliferous. D'Orbigny, again, considered the Albian to be absent from the area taken as the type of the Cenomanian (la Sarthe), and this view is still held by many French geologists, though there are basement beds which some have regarded as older than the true Cenomanian.

When the stratigraphical succession in the north-east of France (Marne, Meuse and Ardennes) came to be better understood, it was found that between the beds which yielded typical Albian fossils and those in which only Cenomanian fossils occurred, thick deposits of sandy marl and fine-grained sandstone (gaize) came in, and that these beds contained a mixture of species, some being such as were originally regarded as Albian and others such as are generally confined to the Cenomanian. In these beds the prevalent *Ammonites* are *A. inflatus* (= *rostratus*) and *A. auritus*, and they came to be known as the zone of *A. inflatus*. Occasionally, however, they contain *Ammonites* of the species *A. mantelli*, *A. varians*, and *A. falcatus*, which are essentially Cenomanian forms.

D'Orbigny was not fully acquainted with the fauna of these beds, but he was aware that the Gaize de Montblainville contained such a mixture of species, and he nevertheless referred it to the Albian.¹ Further, he regarded the Gault of Wissant and of Folkestone as the equivalent of his Albian stage, and in his "Paléontologie Française," *Ammonites inflatus*, *A. varicosus*, *A. auritus*, and *A. mayorianus*, are given as Gault (i.e. Albian) fossils.

The Upper Gault with *Ammonites inflatus* continued to be regarded by most French writers as Albian, up to the year 1874, but Hébert in 1864, and Barrois in 1874, preferred to consider it as Lower Cenomanian, the latter giving as reasons (1) that the Gaize

¹ Vide his "Paléontologie et Géologie Stratigraphique." Tom. ii., p. 622, 1852.

de l'Argonne contains so many Cenomanian species, (2) that this zone overlaps the Lower Gault, and thus in his opinion separates itself from the latter. Later in 1876 Barrois expressly included the Upper Gault of Folkestone and Wissant in the Cenomanian. But he made no estimate of the number of species which united the zone of *Ammonites inflatus* at these places to the beds above, nor did either of them ever discuss the relative values of the different elements of the fauna of the *A. inflatus* zone.

The variation and discordance of opinion in France may be gathered from the change in the grouping of the zones in different editions of A. de Lapparent's well-known "Traité de Géologie." In his edition of 1885 the zone of *A. inflatus* is grouped as Albian, in that of 1892 it is placed in the Cenomanian. The latter method of grouping has been adopted by Mr G. Dollfus for the Service de la Carte géologique de la France. At present, therefore, most French geologists make a very small Albian and a very thick Cenomanian, while the line of separation between the two stages is drawn through the middle of the Gault of Wissant and through a perfectly continuous bed of sandy clay at Havre.

In England we have arrived at very different results; De Rance in 1868 and Price in 1874 showed that the Gault of Folkestone was separable into two divisions—a Lower Gault characterised by *Ammonites interruptus* and *A. lautus*, and an Upper Gault characterised by *A. varicosus* and *A. rostratus*. In 1876 Barrois published his excellent Researches on the Upper Cretaceous Series of England, and proved to us that the greater part of our Upper Greensand was the stratigraphical equivalent of the Upper Gault of Folkestone.

Subsequent investigations have led us to regard the combined Gault and Greensand as a single stage or natural group of beds, to abandon the names Gault and Greensand as denoting definite chronological divisions; they can only be regarded as descriptive of different lithological aspects or facies of the formation, and consequently as serviceable only on maps that are designed to exhibit such lithological variations. Hence we can recognise with Barrois a zone of *Ammonites rostratus* (= *inflatus*), but it is quite impossible for us to accept a classification which groups this zone with the Lower Chalk and separates it from the Lower Gault. We base our refusal on the very principle by which the French themselves profess to be guided, namely, on the faunistic relations of the several zones, and especially on the range and relative abundance of the different species of Cephalopoda.

Now a classification which appears to be the best and most natural expression of the facts in southern England can hardly be unnatural in the north of France, and thus it became clear that some study of the French sections from an English point of view was greatly needed. Such a study was made by Mr W. Hill in

1895, and the results were published in a joint paper with myself on the "Delimitation of the Cenomanian in England and France."¹ Careful and repeated examination of the fine coast section near Havre led us to dissent entirely from Professor Hébert's grouping and to agree with those French geologists who had placed the base of the Cenomanian above the local representative of the Gaize (or zone of *Ammonites inflatus*). We showed, in fact, that the series near Havre is obviously and naturally divisible into an Albian and a Cenomanian, which exactly correspond with the two English stages of (1) Gault-cum-Greensand, and (2) Lower Chalk.

Our descriptions and arguments did not however carry conviction to the mind of Mr G. Dollfus, who discussed the question in February last,² and maintained that our views were not in accordance with the palaeontological evidence. The July and August numbers of the same periodical contain a rejoinder to this attack, in which the friendly challenge was taken up and the palaeontological argument stated more fully than had previously been attempted either in England or France, with the advantage of being translated into French by my courteous opponent himself.

As the French nomenclature has been adopted in most European countries, it becomes a matter of international importance to decide what is to be connoted by the terms 'Albien' and 'Cénomanien.' I desire, therefore, to publish part of my reply to Mr Dollfus in its English version, and this (with a few small corrections) constitutes the remainder of the present article.

Referring to the section at Wissant Mr Dollfus remarks: "If Mr Jukes-Browne wishes us to place the line of separation above the clay with *Ammonites inflatus*, far from making us take a step forward, he would lead us backward; his opinion is that of a period which we out-grew in France twenty-five years ago." That depends on the point of view; I think that twenty-five years ago the geologists of France took a path which deviated from the right road; it is quite true that I seek to lead them back from this wrong path, and I propose that we should walk together along the straight highway of progress. That is my hope, but I know that I have first of all to essay the difficult task of persuading my *confrères* that the path they took was a wrong one.

In the first place let us consider the Cenomanian of the typical area near Le Mans. How was this stage established? D'Orbigny did not go into stratigraphical details, but he studied the fossils which had been found in the beds near Le Mans, and he saw that the fauna as a whole was different from that of the Albian of Dienville and the Gault of Wissant. D'Orbigny, it is true, thought that there was only

¹ *Quart. Journ. Geol. Soc.*, vol. lii., p. 99 (1896).

² *Feville des Jeunes Naturalistes* for February 1898, No. 328.

one fauna at Le Mans, but then he also thought the Albian was not present at Havre, where it is now admitted to exist. In the same way it may be necessary to admit the existence of Albian at Le Mans.

Now what does present itself at Le Mans? I will quote the words of Mr Dollfus: "At Le Mans the base of the Cenomanian consists of sands containing *Ostrea vesiculosa*, *Nautilus subelegans*, *Pecten asper*, *Ammonites inflatus*, etc. These sands rest on Oxfordian beds with *Rhynchonella varians*, without the interposition of any beds belonging to the Lower Cretaceous; this lower limit is therefore very clearly marked, for it is based on a considerable stratigraphical break." But what kind of break is here? There is no break in the Cretaceous series, only an incomplete condition, from the absence of everything below a certain horizon in the series.

It is this very break or hiatus which is a source of difficulty, for, if the succession in the Sarthe had been complete, I do not think this discussion about the base of the Cenomanian would ever have arisen. French geologists have hitherto taken for granted that everything at Le Mans must be Cenomanian down to the local base. It is this to which I object: this assertion must be proved, not taken for granted. My position is this, that the delimitation of the Cenomanian cannot logically or properly be settled in La Sarthe. Its upper limit can be determined there because both Cenomanian and Turonian are fully developed; but its lower limit cannot be determined there; this must be done in some other region where both Albian and Cenomanian are fully represented.

I do not ask my French *confrères* to come to England for the decision of this question, nor do I ask them to accept a new name: I recognise that it is primarily a French business, and I will accept the evidence of the French strata. But I do say this, that the matter must be judged by the evidence of the fossils found in the region which is selected for trial, and that the fossils of La Sarthe must be left out of the account while the comparison is being made between the fauna of the zone of *A. inflatus* with the faunas of the beds above and below it.

Where then in France should this comparison be made? Not at Havre where the Albian is little developed; not in the Pays de Bray where fossils are rare in the Gaize. It is to the east of France that Mr Dollfus himself appeals on this point, maintaining that the fauna of the zone of *A. inflatus* at Wissant and in the Gaize de l'Argonne is so different from that of the zone of *A. interruptus*, that it must be grouped with Cenomanian, not with the Albian. I accept this test, but I do not come to the same conclusion.

Let us take first the Gaize de l'Argonne. Mr Dollfus says that the list published by Mr Barrois shows that 51 species are Albian (Gault Inférieur) and that 70 are Cenomanian; but the latter figure is

his, not that of Mr Barrois, who only says "un assez grand nombre d'espèces cénomaniennes" (a considerable number of Cenomanian species). I do not understand how Mr Dollfus arrives at the 70 unless he brought the fossils of the Sarthe into account. This, I contend, should not be done; those only should be marked which occur above the Gaize in the east of France; *i.e.* those recorded by Mr Barrois in his "Terrain Crétacé des Ardennes," in the beds which lie between the Gaize and the Turonian. I have done this and find that only 48 range upward. The numbers 51 and 48 are so near that it is clear the Gaize de l'Argonne will not decide the question.

We come next to the Upper Gault of Wissant, as to which Mr Dollfus says that d'Orbigny was wrong in referring it to the Albian. I cannot find that any French geologist has published a list of the fauna of the Upper Gault at Wissant. Mr Barrois tells me that he does not know of any such list, and in classing the upper part of the Wissant clay as Cenomanian, he seems to have relied on the proofs of its correspondence with the Gaize de l'Argonne, and on the greater extension or overlap of the zone of *A. inflatus*.

A list of the Wissant fauna has, however, been published in England by Mr F. G. H. Price, who sent the fossil-collector, J. Griffiths of Folkestone, over to Wissant for the express purpose of collecting separately from the Lower and Upper Gault of that place. The results were embodied in a small treatise on the Gault published by him in 1879, but the Wissant lists have never been printed separately. In this connection it will be useful to give a list of the fossils found by Griffiths in the Upper Gault of Wissant, indicating at the same time how many occur also in the Lower Gault of that place and how many range up into the beds above.

	LOWER GAULT.	CENOMANIAN.
<i>Ammonites auritus</i> , Sow.	x	
" <i>cristatus</i> , de Luc.		
" <i>delcruei</i> , d'Orb.	x	
" <i>latidorsatus</i> , Mich.	x	
" <i>lautus</i> , Sow.	x	
" <i>mantelli</i> (?) Sow.		x
" <i>rostratus</i> , Sow (<i>inflatus</i>).		
" <i>splendens</i> , Sow.	x	
" <i>tuberculatus</i> , Sow.	x	
" <i>varicosus</i> , Sow.		
<i>Ancyloceras spinigerum</i> .	x	
<i>Belemnites minimus</i> , List.	x	
<i>Hamites flexuosus</i> , d'Orb.	x	
" <i>elegans</i> , d'Orb.	x	
" <i>intermedius</i> , Sow.	x	
" <i>virgulatus</i> , d'Orb.		
<i>Nautilus clementinus</i> , d'Orb.	x	
<i>Aporrhais parkinsoni</i> , Mant.	x	
<i>Dentalium decussatum</i> , Sow.	x	
<i>Scala dupiniana</i> , d'Orb.	x	
<i>Solarium conoideum</i> , Sow.	x	

	LOWER GAULT.	CENOMANIAN.
<i>Solarium dentatum</i> , d'Orb.	x	?
<i>Anomia</i> sp.		
<i>Arca carinata</i> , Sow.	x	x
" <i>glabra</i> , Sow.	x	x
<i>Cardita tenuicosta</i> , Sow.	x	x
<i>Corbula elegans</i> , Sow.		
" <i>socialis</i> , d'Orb.	x	
<i>Lima parallela</i> , Sow.	x	
<i>Inoceramus concentricus</i> , Sow.	x	
" <i>sulcatus</i> , Sow.		
<i>Nucula ovata</i> , Sow.	x	
" <i>pectinata</i> , Sow.	x	x
<i>Ostrea arduennensis</i> , d'Orb.	x	
<i>Pecten raulinianus</i> , d'Orb.		
<i>Plicatula pectinoides</i> , Sow.	x	x
<i>Terebratula biplicata</i> , Sow.		x
<i>Serpula articulata</i> , Sow.		
<i>Cidaris gaultina</i> , Forbes.		
	27	7 or 8

In the above list there are 38 named species, and of these no fewer than 27 occur in the Lower Gault of the same place, which is in the proportion of 71 per cent., while only 7 or 8 (about 20 per cent.) range into the Cenomanian beds above. D'Orbigny, it therefore appears, was perfectly right in classing the Upper Gault as Albian and there is no necessity for revising the lists of the Albian fossils given by him in his "Prodrome." It is Messrs Barrois and Dollfus who have made a mistake by classing the Upper Gault as Cenomanian without a sufficient study of its fauna.

Turning now to England, let us choose localities which correspond most nearly with Wissant and with l'Argonne; it is generally admitted that the Gault of Folkestone is an expansion of that of Wissant, and it will not be denied that the Gaize of Devizes resembles that of Argonne.

I have made a list of the fossils of the Upper Gault of Folkestone, basing it on that of Mr Price (*Quart. Journ. Geol. Soc., Lond.*, 1874) supplemented by his later record in 1879. Selecting the Mollusca and neglecting other fossils, I find that the Upper Gault has yielded 103 named species; of this number 54 occur also in the Lower Gault, while only 29 range upward into the Chloritic Marl and Lower Chalk (Cenomanian) of Kent. Here, therefore, the zone in question has a much more decided affinity with the beds below than with those above.

Passing to the Gaize of Devizes my lists are not quite complete, but they include 92 species of Mollusca, and no less than 44 of these do not range out of the zone of *Am. rostratus* (or *inflatus*), but 36 occur in the Lower Gault of Wiltshire and Folkestone, while only 18 range into the Warminster sand, and 20 into the Lower

Chalk (including the zone of *Stauronema*). Here also the true relations of the fauna are quite clear.

In this study of the fauna of the English zone of *Am. rostratus* I have excluded Echinoderms, because their evidence is not of first-rate value; in support of this opinion, I may quote that of Dr J. W. Gregory of the British Museum, who has remarked that, "Echinids are rather a clue to the conditions of formation of deposits than evidence of their exact contemporaneity in age." Thus it may be quite true, as Mr Lambert declares, that the affinities of the Echinoidea found in the Gaize of Havre are Cenomanian, but their evidence cannot weigh against that of the Cephalopoda which are most clearly not Cenomanian.

Mr Dollfus quite omits to notice that I have appealed to the Cephalopoda as affording the best criterion of the affinities of the fauna of these beds. Let us see what this criterion proves.

From the Upper Gault of Folkestone Messrs Price and De Rance have recorded 31 species of Cephalopoda, and of these 12 range down into the Lower Gault, and only 4 range into beds above. Similarly in the Gaize of Devizes there are 20 Cephalopods, of which number 7 occur in Lower Gault and 4 range into higher beds. Both at Folkestone and Devizes *Ammonites rostratus* and *A. varicosus* are restricted to the Gaize and Upper Gault, but in the counties of Buckingham and Bedford, I have myself found both species in the Lower Gault. In two cases they were in company with *A. lautus* and *A. splendens* about 30 feet from the base of the Gault which is there 200 feet thick; in a third case they occurred with *A. interruptus* quite near the base of the Gault. With respect to the upward range of *A. rostratus*, it passes upward into the green glauconite sands above the Gaize, both in Wiltshire and Dorset, and where the Chert Beds are absent, I have found it within six or seven feet (two metres) of the top of the Upper Greensand. No Ammonites have yet been found in the Chert Beds, but *A. rostratus* has never been found above them.

Next let us consider the true Cenomanian group of Cephalopoda:—*Ammonites varians*, *falcatus*, *mantelli*, *navicularis*, *rotomagensis*, *Scaphites aequalis*, *Turrilites costatus*, *tuberculatus*. No one who has collected along the south coast of England or at Wissant, or at Havre, could doubt where these species first set in as common fossils; they come in with *Stauronema carteri* and *A. laticlavus* in what is generally called the Chloritic Marl.

It is only occasionally and locally that any of them occur below this horizon, but so far as my experience goes not one of them ranges further than six feet below it. *A. varians*, *falcatus* and *navicularis* are not uncommon at the top of the Greensand between Warminster and Maiden Bradley, but are not associated with *A. rostratus*; the bed in which they occur is evidently a passage bed from Greensand to Chloritic Marl.

I only know of two cases where *A. varians* and *A. rostratus* are said to be associated: one is in the highest bed of the Greensand in North Dorset where both are rare. The other is the record by Mr Price of *A. varians* from his bed XI. at Folkestone, but the *variens* was a doubtful specimen and no other has since been found. Mr Munier-Chalmas states that *A. varians* occurs with *A. rostratus* in the East of France, and doubtless it does occur occasionally at the summit of the *A. rostratus* zone. Such occurrences are not rare near the junction of two stages, and they only prove that there is no hard and fast line separating one fauna from another. It is generally conceded that in the delimitation of zones or stages, we must be guided by the abundance of certain characteristic species not by the mere occurrence of one or two of them. Consequently those who argue that the zone of *A. rostratus* must be Cénomanien because *A. varians* sometimes occurs near the top of it are reversing the rule, and seek to establish a precedent which would destroy our principles of classification.

Mr Dollfus has said "it is an illusion to think that we can ever possess a perfect classification which would satisfy geologists of all countries." That is quite true, but it is not an illusion to believe that we can frame a classification which will suffice for one stratigraphical province or basin of deposition, such as that of England or Northern France.

I do not seek to upset the French nomenclature, on the contrary I recognise that the French will accept no other nomenclature. Endeavours have been made to employ it in England, but at present that is impossible. D'Orbigny's names have been so wrested from their original application by the modern French geologists that many English geologists think that these names no longer possess any fixity of meaning; consequently they oppose the adoption of them. There are of course some who see that the alterations are merely personal views of grouping, and that the faunistic differences on which the names were founded remain the same. So far as the divisions of the Chalk are concerned, we may eventually be able to employ the French names, and the time will be hastened if our French *confrères* will restrict the Cenomanian to its proper limits; but with respect to the English Gault and Greensand I see no alternative but to propose a new name.

I hope at any rate to have made it clear that I do not advocate "a return to antiquated classifications based mainly on mineralogical facies." On the contrary I believe that Mr Dollfus and I are in perfect accord in regard to the principles of classification. We both consider palaeontology and stratigraphy to be the true guides, and we only differ because we interpret the teaching of these guides in different ways.

A. J. JUKES-BROWNE.

SOME NEW BOOKS

WELWITSCH'S AFRICAN PLANTS

CATALOGUE OF THE AFRICAN PLANTS collected by Dr Friedrich Welwitsch in 1853-61. Dicotyledons, Part II., Combretaceae to Rubiaceae. By W. P. Hiern, British Museum (Natural History). 8vo, pp. 337-510. London: Printed by order of the Trustees. 1898. Price, 4s.

THE number of those who have braved the dangers and discomforts attendant upon botanical journeys in distant countries is continually on the increase. Such men, to cite only a few names, as Robert Brown, Von Martins, Spruce, Weddell, Hooker, Beccari, have highly distinguished themselves by honourable labour in this department of science, and their services have been gratefully recognised by the world at large. But among them all, none is more worthy of recognition than Dr Friedrich Welwitsch, who, for eight years, explored the at that time all but unknown Portuguese possessions in the south west of Africa. Welwitsch's great merit resides in the thoroughness with which he set himself to perform his allotted task. It is one thing to pass rapidly through a country, plucking specimens when opportunity offers, as a member of an expedition protected by all the resources of civilisation against the many unpleasantnesses which would otherwise have to be encountered. Very different must it be when the solitary traveller has to rely upon his own devices; when year by year he struggles on against the scorching heat of the tropics, against the swarming insect life, whose only object seems to be the reduction of man to the lowest ebb of wretchedness, against the vicissitudes of the seasons with the inevitable diseases lurking in their train, against the ever-present danger from noxious animals and still more noxious members of the human race. All this Dr Welwitsch did, and the result is seen in the truly splendid additions to our knowledge of the tropical African flora which we owe to his instrumentality. No one could possibly have turned his opportunities to better account; and when we search the record of achievement in this branch of knowledge, we fail to remember one explorer who, in the matter of scrupulous care in the selection of his specimens, and ungrudging toil and sagacity in the writing of the notes to accompany them, can be mentioned as Welwitsch's equal.

Unfortunately the great explorer died before he was able to give to the world the full result of his unparalleled efforts; but a fine set of the plants, equal to all intents and purposes to the first set now at Lisbon, was happily secured by the Trustees of the British Museum. Owing to pressure of work, these plants for some years remained undescribed; meanwhile sets of inferior value were distributed from Lisbon to various herbaria, and by these means descriptions of Welwitsch's novelties have exercised the pens of various botanists from time to time. But desultory work of this kind, however useful it may be, is scarcely a worthy way of dealing with the subject; it is therefore a matter for

unalloyed satisfaction that Mr Hiern has stepped into the breach by undertaking a full elucidation of Welwitsch's collections. In the second part of the memoir devoted to this object, the one we are here noticing, the interest aroused by the appearance of the first part is fully maintained, as is also the high reputation of the author. Mr Hiern is well known for the painstaking accuracy of all his work; he is, also, a man whom, in any case when divergency of view is admissible, one would much rather have on one's own side than as an opponent. Moreover, the excellent judgment he displays in making full use of the explorer's notes, gives him an extra claim on our gratitude. True, we have one objection to make in respect of this, an objection which may perhaps seem odd as coming from an Englishman. We think that too much of the memoir is written in our own language. After all, Welwitsch was a German, and the country he so thoroughly explored is a possession of the Portuguese crown. Moreover, a large number of those to whom the work appeals are foreigners. If, therefore, our objection be ruled invalid so far as concerns the notes themselves, we certainly see no good reason for departing from the time-honoured practice of describing in Latin at least the salient features of a new plant. By the use of Latin a person of any nationality at once knows what an author is driving at, and we can only hope that our Russian and Hungarian brethren will not resort to reprisals; otherwise troublous times are in prospect.

Combretaceae occupy the place of honour in the present part; thence we pass on to Myrtaceae, and so through the remaining calycifloral orders to the first order of the Gamopetalae, the Rubiaceae, and with this the part closes. We much like the pithy introductions to the principal orders, wherein geographical data, economic uses, and so forth are skilfully detailed. As regards nomenclature, we are glad to see that Mr Hiern does not lend himself to the extreme views prevalent in some quarters. To most of the changes he introduces no one who admits the advisability of change at all can possibly object. But we must confess that had the original disturber of nomenclature come to us for advice regarding the use to be made of his portentous knowledge, we should have felt disposed to answer in the words of the lady at the close of Mr Austin Dobson's delightful lovers' quarrel:—

"I'd say no more about it
If I were you."

But a great deal has been said about it, and much more written, so that one begins to think the best way out of the difficulty to be the adoption of the change as soon as possible. We grieve, though, to see an old and familiar name like *Psychotria* disappear; a change involving scores of species, and a large addition to the list of synonyms. And why does Mr Hiern refrain from attaching his name to species now for the first time ranged under some new denomination? Thus he prints *Myrstiphyllum cristatum* (the new name for the old *Psychotria cristata*, Hiern) without appending any authority, and so on throughout the work.

Oversights are very rare; but such a sentence as this—"Africa is but little favoured with the natural occurrence of Myrtaceae" is far from elegant, though it is only fair to say that we have found no

similar case of faulty diction. On p. 371 *Rotala verticillata* is printed for *R. verticillaris*, and "near genus" (p. 388) should obviously be "new genus." But errors like these are unimportant and, indeed, almost unavoidable. The main point to recognise is that we have here the second instalment of a work which shows excellent promise of proving creditable alike to the author and to the naturalist of whose 'grit' and sagacity it bears such unequivocal signs.

FOR AMATEUR GARDENERS

GARDEN-MAKING: Suggestions for the use of home grounds. By L. H. Bailey, aided by L. R. Taft, F. A. Waugh and Ernest Walker. 8vo, viii + 418 pp. New York: The Macmillan Co. 1898. Price 4s. net.

THE PRUNING-BOOK: A monograph of the Pruning and Training of Plants as applied to American conditions. By L. H. Bailey. 8vo, xii + 538 pp. New York: The Macmillan Co. 1898. Price 5s. net.

ALTHOUGH these two charming little books are written primarily for American readers, they should be none the less welcome in this country. There are many things that we can learn from the ingenuity of our Transatlantic cousins, and under the guidance of Professor Bailey, we are sure to do so in the most pleasant manner possible. The number of books that this genial author contrives to publish during a single year is a marvel in itself, even making allowance for the help of various colleagues; but what is even more remarkable is the verve with which each is written. Professor Bailey, it is clear, enjoys writing his books, and that is why we all enjoy reading them. The illustrations, too, are always good and appropriate.

The book on Garden-making is original, with quaint fancies here and there, but practical withal. Its opening paragraph is one of the most fascinating introductions to a fascinating subject that we remember. Let us quote some sentences. "Every family can have a garden . . . one plant in a tin may be a more helpful and inspiring garden to some mind than a whole acre of lawn and flowers may be to another. The satisfaction of a garden does not depend upon the area, nor, happily, upon the cost or rarity of the plants. It depends upon the temper of the person. One must first seek to love plants and nature, and then to cultivate that happy peace of mind which is satisfied with little. If plants grow and thrive, he should be happy; and if the plants which thrive chance not to be the ones he planted, they are plants nevertheless, and nature is satisfied with them. . . . We are happier when we love the things which grow because they must. A patch of lusty pigweeds, growing and crowding in luxuriant abandon, may be a better and more worthy object of affection than a bed of coleuses in which every spark of life and spirit and individuality has been sheared out and suppressed. The man who worries morning and night about the dandelions in the lawn will find great relief in loving the dandelions. Each blossom is worth more than a gold coin as it shimmers in the exuberant sunlight of the growing spring, and attracts the bees to its blossom. Little children love the dandelions: why may not we? Love the things nearest at hand, and love intensely. If I were to write a motto over the gate of a garden, I should choose the remark which Socrates made

as he saw the luxuries in the market: 'How much there is in the world that I do not want!'"

The Pruning-book is eminently practical, but in the right way. All the advice is based on a body of solid principles, and these are explained by reference to the life-histories of various typical branches. Anyone who has mastered the instances given by Professor Bailey should be able to work out for himself the correct mode of pruning any unfamiliar tree. A hundred and forty pages are devoted to American viticulture, but this need not be grudged by us, as the rest is well worth the money.

BIRDS NEAR SYDNEY

THE BIRDS OF THE COUNTY OF CUMBERLAND. By Alfred J. North, C.M.Z.S., Australian Museum, Sydney. Reprinted from the Handbook of Sydney and the County of Cumberland. Melbourne: George Robertson & Co. 8vo, pp. 116.

MR NORTH has produced a useful pamphlet for local ornithologists. His list of twenty-one species does not include any but well-known Australian birds; but it has been compiled with manifest care, and should enable any visitor to ascertain what species he might hope to study during a few months' residence within the prescribed topographical limits. It is satisfactory to learn that the Lyre-bird (*Menura superba*) still frequents certain spots in the mountain ranges, and that the Black Swan (*Chenopsis atrata*) is still common in most of the inlets along the coast. Our information concerning the Freckled Duck (*Stictonetta naevosa*) is already so meagre that we wish that Mr North could have supplemented his reference to the occurrence of this bird in New South Wales in 1897, with a few fresh facts as to its life history. The families of *Timeliidae* and *Meliphagidae* include many of the most characteristic Aves of this district; but the Order *Psittaci* is also much in evidence.

H. A. MACPHERSON.

ALEXANDER GOODMAN MORE

LIFE AND LETTERS OF ALEXANDER GOODMAN MORE, with Selections from his Zoological and Botanical Writings. Edited by C. B. Moffat, B.A., with a preface by Frances M. More. 8vo, pp. xii. 642. Dublin: Hodges, Figgis & Co., 1898.

THE late Mr A. G. More possessed such a charming personality that there could be no doubt as to the wisdom of republishing his correspondence with the late Charles Darwin, Professor Newton, and other well-known zoologists. But the present volume does far more than this. A large portion of the text is occupied by pleasant letters and extracts from the diaries of the late Curator of the Dublin Museum; but more than two hundred pages are devoted to the reproduction of Mr More's essays and papers on Irish botany and zoology. Two of these articles are of wider interest than the rest, viz., those on the "Distribution of Birds in Great Britain during the Nesting Season," and the "Geographical Distribution of Butterflies in Great Britain." The former may indeed be considered classical, and proved of the utmost value to later workers. But A. G. More expended his greatest efforts in advancing the extension of Irish natural history. The impetus which his personal influence lent to the original researches of such Irish naturalists as Barrington and Barrett-Hamilton can best

be ascertained by a careful study of these pages. The most valuable piece of work which poor More accomplished during his later years was undoubtedly the official list of Irish Birds; the second revised edition of which appeared in December 1889, and is now reproduced, with footnotes by the Editor and Dr Scharff, which bring it fairly up to date. The statement (p. 368) that the specimen of *Turdus migratorius* procured in Ireland in 1891 was the first obtained in Europe is, of course, a mistake, at least five examples having been proved to have strayed across the Atlantic previously, one of the number having occurred in England in 1876; but this is a venial fault. The Shearwater, catalogued as a specimen of *Puffinus obscurus*, obtained off the Kerry coast in 1853, has recently proved to be *Puffinus assimilis*; but in other respects this catalogue of Irish birds is invaluable for reference purposes. The smaller papers on Irish zoology cover a variety of ground, and the index has been carefully compiled. H. A. M.

SOME JAMAICAN JELLY-FISH

THE CUBOMEDUSAE. By Franklin S. Conant. Memorial Vol., with Biographical Sketch. *Mem. Biol. Lab., Johns Hopkins Univ.* IV. Part 1, xvi + 62 pp., viii. pls. and frontispiece. Baltimore, 1898.

THE friends of the late Dr Conant, with the aid of the Johns Hopkins University, have printed in the form of a memorial volume his dissertation on the anatomy of the Cubomedusae.

There is no group of the Coelentera which needed the careful investigation of a clever student more than the one which Conant chose for the subject of his thesis for the degree of Doctor of Philosophy at the John Hopkins University.

The Cubomedusae present so many features of exceptional interest that zoologists have felt very keenly that a reinvestigation of their anatomy and a study of their development were among the most important pieces of work yet to be done in the group of the Coelentera. The investigations of Claus and Haeckel, who were able to study preserved material only, are necessarily incomplete and unsatisfactory, and Conant seized the opportunity which the discovery of large numbers of the living medusae on the coast of Jamaica gave him of reinvestigating the whole subject. There can be no doubt in the minds of those who read the volume which records the results of his labours, that this contribution to science is a solid and valuable one. His descriptive writing is remarkably lucid, his reasoning clear, and at the same time cautious, and the numerous illustrations to the memoir are admirable. With such impressions framing themselves as we read the pages, there comes the feeling that in Conant we have lost a zoologist who had every prospect before him of a brilliant career in the scientific world. His patient and noble devotion to the cause he had at heart demands our admiration, and calls out our sympathy for his friends and fellow-workers in America who mourn his untimely death.

The species that Conant had to work upon were *Charybdea xaymacana* and *Tripedalia cystophora*, both of which were found in Kingston Harbour, Jamaica, the latter being the sole representative of the new family Tripedaliidae. The habit of these two species is

not their least remarkable feature. The Cubomedusae were generally considered to be deep-sea forms, but both these species are found at the surface and near the shore. *Tripedalia* occurs—very locally—in water that is not only very shallow but discoloured with organic matter, with a bottom of black mud. It is very unfortunate that Conant was unable to complete his embryological investigations, but the following note on p. 23 concerning *Tripedalia* is of very great interest. "The embryos were thrown out in the Aquaria as free-swimming planulae, which settled down on the bottom and sides of the glass in a day or two, and quickly developed into small hydras with four tentacles. . . . In this condition they lived for three weeks without essential change, and they were still giving no promise of further development when the laboratory broke up and the jars had to be emptied."

Tripedalia is the smallest form of the Cubomedusae, the height of the bell in the largest individuals being only 8 or 9 mm., whereas of the twenty species mentioned by Haeckel only two are less than 20 mm. in height. The generic name is given to it on account of the prominent feature of the arrangement of the tentacles in groups of three, with separate pedalia. Further details of the anatomy of this new genus are given in the text.

The greater part of the dissertation is occupied by an admirably lucid account of the anatomy of *Charybdea xaymacana*, containing several new points of interest; but perhaps the most important part is the detailed description of the vascular lamellae and the nervous system of the Cubomedusae at the end of the volume. It will be noted with some interest that Schewiakoff's account of the histology of the eyes was not confirmed in all details. It will be remembered that Schewiakoff recognised in the retina two kinds of cells which he named visual cells and pigment cells respectively. This Conant was unable to do; in fact he found considerable evidence against the two types of retinal cells, and he found that the long pigment streaks are parts of retinal cells continued into processes like Schewiakoff's visual cells.

There is one point in the Memoir which needs criticism in case it is copied by others who succeed Dr Conant in the literature of Medusae. The use of the word 'gelatine' in the sense in which the word 'mesogloea' is used in this country is not justifiable. Mr Sedgwick in his recently published text-book objects to the word 'mesogloea' because "it suggests an ectogloea and entogloea which do not exist," and says that when the supporting lamella is thick and bulky it is simply called the 'jelly.' There is no very serious objection to the use of the word jelly in this manner, because it implies nothing more than a substance of jelly-like consistency; but the word 'gelatine' implies a definite chemical character, and all the evidence we have at present tends to prove that the mesogloea of Coelentera is not gelatine but mucin. It is therefore to be hoped that the word 'gelatine' in the sense in which it was used by Dr Conant will be dropped and the word mesogloea take its place. Mr Sedgwick's objection to the word cannot be considered a very serious one, for it would be equally applicable to the word mesentery, which he uses throughout his book.

SYDNEY J. HICKSON.

THE SKELETON OF MARYLAND

MARYLAND GEOLOGICAL SURVEY. Volume One. By Wm. Bullock Clark, State Geologist, E. B. Matthews, and L. A. Bauer. 8vo, 540 pp. and 17 plates.

WITH its first volume of Reports, the Geological Survey of Maryland makes an imposing, attractive, and generally successful start. This Survey has the benefit, inestimable in America, of being removed from the immediate control of politicians, since it is under the direction of a commission "composed of the Governor, the Comptroller, the President of the Johns Hopkins University, and the President of the Maryland Agricultural College." We may therefore expect the fulfilment of the promise that other volumes will follow, dealing with the mining, geology, palaeontology, mineralogy, forestry, agricultural physics, and so forth.

The present volume opens with an Introduction by Professor Clark, who relates the history of the establishment of the Survey, describes its plan of operations, and then gives an account of the progress of investigation concerning the physical features and natural resources of Maryland. This is followed by an outline of present knowledge of the physical features of the State, embracing an account of the physiography, geology, and mineral resources. This also is from the pen of Mr Clark; it occupies 87 pages, and is illustrated by a hypsometric and a geological map and several photographic plates of scenery. A useful appendix to this is a bibliography and cartography of Maryland, with special reference to its geology, by Dr E. B. Matthews, who was assisted in the compilation by all the members of the Survey. The volume concludes with the First Report upon Magnetic work in Maryland, by Dr L. A. Bauer, who has been conducting this division of the work of the Survey.

The State of Maryland forms part of the eastern border region which stretches from the Atlantic coast to the crest of the Alleghanies, and from its central situation affords, perhaps, the most characteristic section of this broad belt. In Maryland, as elsewhere, this part of the continent is divided into three physiographic areas: the Coastal Plain, the Piedmont Plateau, and the Appalachian Region. The Coastal Plain includes rather over one half the land area of the State (nearly 5000 square miles), and attains in places a width of 100 miles. By the great Chesapeake Bay, running north and south, it is divided into the very low-lying Eastern Maryland, and a higher western tract usually called Southern Maryland. The Piedmont Plateau occupies somewhat over one quarter of the land area of the State, being about 65 miles wide in the north, and gradually narrowing to 40 miles in the south. It is divided by Parr's Ridge into an eastern and western division. The former has a diversified topography due to varied crystalline rocks with complicated structure; in it are broad, fertile limestone valleys running in various directions. The western division includes the broad limestone valley of the Monocacy, on which is the town of Frederick, and near the mouth of which is Sugarloaf Mountain rising rapidly to a height of 1250 feet. The Appalachian Region extends from the Piedmont Plateau to the western limits of the State; it comprises about 2000 square miles, and attains a maximum width of 115 miles in the northern part of Mary-

land. It consists of parallel mountain ranges, with deep valleys, which are cut, nearly at right angles, throughout much of the distance, by the Potomac river. It is divided into three districts, based upon clearly defined geological differences; these are an eastern (Blue Ridge and Great Valley), a central (Appalachian Mountains proper), and a western (Alleghany Mountains).

Within the relatively small limits of the State of Maryland there is hardly an important geological epoch that is not represented, the most important omissions being in the Jurassic, with the possible exception of its later portion. The seven regions just indicated are each composed of a distinct series of geological formations. The beds of the Coastal Plain are nearly horizontal, still there is a predominance of the latter Cainozoic formations in the eastern division, and of Mesozoic and early Cainozoic rocks in the western. East of Parr's Ridge, in the Piedmont Plateau, is a sequence of highly crystalline rocks, largely igneous, which represent the remains of a vast Archæan Continent, whose detritus furnished the Palæozoic sediments. West of Parr's Ridge are greatly folded and metamorphosed, but less crystalline, beds of early Palæozoic time; the Frederick valley, above alluded to, lies in blue Palæozoic limestone in part overlaid by the red sandstone and shale of Mesozoic age. In the Appalachian region, Blue Ridge and Great Valley are in Cambrian and Lower Silurian (= Ordovician) rocks, in places so eroded as to expose the Archæan floor; the Appalachians are built of Upper Silurian and Devonian strata; the Alleghanies are composed of more gently folded Devonian and Carboniferous deposits, carrying the valuable coal seams of the Cumberland basin.

It is thus clear that ample opportunity is afforded to Professor Clark and his assistants of producing a series of memoirs of varied and profound geological interest. The present volume forms an excellent basis, and augurs well for the future.

DOWN AND ANTRIM FOR THE HOLIDAYS

BELFAST AND COUNTY DOWN RAILWAY COMPANY. OFFICIAL GUIDE TO COUNTY DOWN AND THE MOURNE MOUNTAINS. By R. Lloyd Praeger, with seventy [reproductions of] photographs of Scenery by R. Welch, Belfast, maps, and other illustrations. 8vo, xvi + 232 pp. Belfast: Marcus Ward & Co. 1898. One Shilling.

OFFICIAL GUIDE TO THE BELFAST AND NORTHERN COUNTIES RAILWAY, THE GIANT'S CAUSEWAY, AND THE ANTRIM COAST. Maps and illustrations. 8vo, viii + 172 pp. Belfast: W. & G. Baird. 1898. Sixpence.

THESE are two excellent handbooks for the tourist in Counties Down and Antrim. Of late years a very great improvement has taken place in the accommodation for visitors to the North-east and the West of Ireland especially, and travel there is as comfortable as anywhere. There is no better holiday in our opinion than a fortnight spent between Belfast and the Giant's Causeway, with a day or two spared for the Mourne Mountains. These guide-books cover the exact area, and are indispensable each in itself and as supplying the gaps in the other. The first on our list is compiled by the well-known President of the Dublin Naturalists' Field Club, and that alone should secure it a large sale. It deals in an equally able manner with the History, Archaeology, Sports, Artistic merits, Natural History, and Geology, and these in no mere perfunctory way. It has several maps, one of which, by Professor M. F. Fitzgerald, is of great value, as it gives for the first time the

contours of Newcastle district of the Mourne Mountains. There is scarcely need to mention the photographic reproductions of Mr Welch, every reader of *Natural Science* must be familiar with them; but it may be as well to note that the original photographs naturally far surpass these reproductions. For these alone it will repay every geologist to invest his shilling.

The other book is of quite similar class to the first, which, as we said above, it complements. Here the Geology is dealt with by Professor Cole, the Botany by Mr Praeger, Fishing by J. S. Hamill, Antiquities by W. Gray, and Sketching localities by Miss Sydney Thompson. An excellent and liberal selection of Mr Welch's views are also drawn upon, and many other pictures of interest. We note the exterior and interior of the homestead of Francis M'Kinley, whose descendant is now President of the United States. Like the above book, this is of especial interest to geologists by reason of its pictures, and we strongly recommend it to any one who has seen or is interested in the district of Larne to the Giant's Causeway.

VITALISM

DURING the recent academical year Prof. Léo Errera, of the Université Libre of Brussels, lectured on the question—"Is there such a Thing as a Vital Force?" He has been good enough to send us a syllabus of his lectures, which contains a very useful bibliography of the subject. He comes to the conclusion that there has not yet been demonstrated in living beings any source of energy independent of external energies, although the resultant of these various energies, as exhibited in the structure of an organised being, may conveniently be spoken of as 'vital.' To abstract what is itself an abstract is hardly possible for us; but those who are interested in the subject might do worse than write to the Libraire Lamartin, Rue Marché-aux-Bois, Bruxelles, for a copy, which costs 75 centimes.

THE zoological results of Dr Arthur Willey's travels in New Britain, New Guinea, the Loyalty Islands, and other islands of the South Pacific, during 1895-97, are to be published by the Cambridge University Press in a series of monographs. The writers, besides Dr Willey himself, include Dr Paul Mayer, Mr R. I. Pocock, Dr D. Sharp, Prof. S. J. Hickson, Mr A. E. Shipley, and Mr Jeffrey Bell. The work is expected to be completed in five or six parts, of which two will be issued during the autumn.

WE have received from Messrs Blackie & Son a small manual, entitled "Elementary Chemistry, Practical and Theoretical, First Year's Course," by T. A. Cheetham. Since this is outside our scope we can only say that Mr Cheetham appears to have combined the practical and theoretical divisions of his subject in an intimate and successful manner. The descriptions of the experiments are clear and should enable them to be carried out easily by the student.

SCRAPS FROM SERIALS

To the paper of Mr Jukes-Browne, which appears in its English form in the present number, a reply by Mr G. Dollfus, entitled "Rôle de la

stratigraphie dans la classification Géologique," was published in the August number of *La Feuille des jeunes naturalistes*. Evidently the discussion has cleared the ground, and though the compromise suggested by Mr Dollfus is not likely to be accepted by Mr Jukes-Browne, there are signs that an agreement may be arrived at eventually.

In the *Westminster Review* for August, Mr J. F. Hewitt has an article on "The Smithsonian Institution: Its history and its later Ethnological publications."

No. 4. of vol. iii. of the *Records of the Australian Museum* was published on June 13, and contained a description of new or little known Palaeozoic Gastropoda from Victoria, Tasmania, and N.S. Wales, referred to the genera *Goniostropha*, *Mourlonia*, *Helicotoma*, *Trochonema*, *Holopea*, and a new genus *Gyrodoma* allied to *Murchisonia*, by R. Etheridge, jun., who also founds a new species *H. australis*, for specimens of the Silurian chain-coral, *Halysites*, from N.S. Wales. In the same number W. J. Rainbow describes the larva of the geometrical moth *Pseudoterpnæ percomptaria*, and a new species of Araneid, *Poltys multituberculatus*. C. Hedley describes and figures *Lima alata*, a new bivalve from Santa Cruz, S. Pacific. A. J. North furnishes a series of ornithological notes.

Part 2. of vol. ii. of *Annotationes Zoologicae Japonenses* is to hand, and contains a paper by C. Sasaki on the wild and domestic silkworms of Japan, in which he comes to the conclusion that the latter are derived from *Theophila mandarina*. Prof. Ijima contributes a preliminary synopsis of the genera and species of the sponge family Rossellidae. Yet another preliminary notice we regret to see is that of new Japanese Echinoids by S. Yoshiwara; in this ten species are somewhat briefly described without any illustrations.

Volume iii. of the *Journal of the Essex Technical Laboratories* fully carries out the promise of earlier volumes, and Mr Houston and his assistants are to be congratulated on the success that has attended their efforts in the teaching of science as applied to agriculture and dairy-farming. The lectures on dairy bacteriology are particularly valuable.

FURTHER LITERATURE RECEIVED

OUTLINES of Vertebrate Palaeontology, A. S. Woodward: Cambridge, Nat. Sci. Manual. Natural Hygiene, Lahmann; Radiation, Hyndman; Sonnenschein, London. Plant Life, Barnes: Holt, New York. Classification of Vertebrata, Gadow: Black, London.

The Periodical Cicada, Marlatt: *Bull. U.S. Dept. Agriculture*. Minnesota Botanical Studies, ser. ii., part 1. Report Manchester Micro. Soc., 1897. Clays in New Jersey (no reference given), and Soundings from the Pacific, Edwards: *Amer. Micro. Journ.* Importation of San José Scale from Japan, Webster: *Canadian Entomologist*. Transactions Norfolk Nats. Soc., vol. vi., part 4. Report S. African Mus., 1897. Flat-fishes of Cape Colony, Boulenger: Dept. Agriculture, C. of Good Hope. L'origine des individus, Herrera: *Mem. Soc. Antonio Alzate*. The Temperance Question, Reid: *Medical Mag.* Report Manchester Mus., 1897-98. Seams of Lancashire Coal measures, Bolton: *Manchester Mus. Handbook*. Rev. Mensuelle de Bibliogr. Scient., Baillière.

Amer. Journ. Sci., Aug.; Amer. Micro. Journ., June, July; Amer. Nat., June, July; L'Anthropologie, May-June, vol. ix., No. 3; Avicula, May-June, July-Aug.; Boll. de Naturalista, xviii., No. 7; Botan. Gazette, July; Feuille des jeunes Nat., Aug.; Irish. Nat., Aug.; Knowledge, July, Aug.; Literary Digest, July 9, 16, 22, 30, Aug. 6; Naturalist, Aug.; Nature, July 21, 28, Aug. 4, 11; Nature Notes, Aug.; New Age, June; Photogram, Aug.; Plant World, July; Review of Reviews, July; Revue Scient., July 23, 30, Aug. 6, 13; Riv. Ital. Sci. Nat., July and Aug.; Rev. polit. e litteraria, iv., fasc. 1; Science, July 8, 15, 22, 29, Aug. 5; Scientific Amer., July 9, 16, 23, 30, Aug. 6; Riv. Psicologia, June, fasc. 4 and 5, July, fasc. 6; Scot. Med. and Surg. Journ., Aug.; Scot. Geogr. Mag., Aug.; Victorian Nat., June, July; Westminster Rev., Aug.

NEWS

PROFESSOR E. RAY LANKESTER has been appointed Director of the Natural History Branch of the British Museum. We have on a previous occasion expressed our admiration of Prof. Lankester's biological work. Further than this he has shown, by the excellent museum installations carried out under his guidance at Oxford, how well he is fitted to continue the exposition of the national collections on the lines laid down by Owen and Flower. All who have ever had the pleasure of working under him admit with gratitude the inspiration and guidance they have received, and recognise that his powers are remarkably adapted for the direction of a great scientific establishment. We fail to see how a more fitting person could have been found.

DR D. MORRIS, of Kew, has been appointed head of a newly founded government department to direct practical applications of botany in the West Indies. We fear that the learned gentleman will not be welcomed with open arms by the many botanists in those parts, which already have an excellent Botanical Garden and staff in Jamaica.

OTHER recent appointments are those of Dr Charles Hunter Stewart to the professorship of Public Health and Sanitary Science at Edinburgh University, and Dr Heinrich Ries, of Columbia University, to be instructor in Economic Geology, a newly created post at Cornell University.

AFTER serving the Museum of Comparative Zoology in various capacities for thirty-five years, Mr Alexander Agassiz has resigned his position as Director and Curator. The policy of the establishment will hereafter be guided by a Committee of the Museum Faculty of Harvard, consisting of Dr H. P. Walcott and Professor George L. Goodale. Dr W. McM. Woodworth has been appointed assistant in charge of the Museum, to date from August 1, 1898.

PROFESSOR JAMES HALL, State-Geologist of New York, died on August 7th, having nearly completed his eighty-seventh year. We hope to devote a special article to this famous American geologist in our next number.

THE new galleries of comparative anatomy, anthropology, and palaeontology, at the Museum of Natural History, Paris, were opened on July 21.

THE U.S. National Museum has recently acquired the Lacois collection of fossil insects. It is said to contain over 6000 specimens.

DURING two years of active work in amassing an herbarium in connection with the Botanical Department of the Field Columbian Museum, Chicago, over 50,000 mounted and classified sheets have been accumulated; these are distributed geographically about as follows:—North America, 16,000; Mexican Boundary, 1575; Mexico, 6125; Central America, 1575; West Indies, 1050; South America, 1500; Europe, 10,500; Asia, 4500; Africa, 3850; Japan, 1050; Oceania, 1200; Australasia, 2250.

WE regret to learn that the young male giraffe recently bought by the Zoological Society died on the night of Monday, August 8, from indigestion.

THE Lincolnshire Naturalists' Union, joined by members of the Lincolnshire Science Society, and the Grantham, Grimsby, and Louth Naturalists' Societies, met at Grantham on June 7, and had a very successful excursion to Saltersford, Stoke Park, Woolsthorpe Manor House, and Little Ponton. A report by Rev. E. A. Woodruffe-Peacock, with lists of specimens collected, appeared in *The Naturalist* for August.

ON August 1 the Yorkshire Naturalists' Union made an excursion to Spurn, and succeeded in collecting many specimens of interest.

THE Geologists' Association of London held their Long Excursion in the Birmingham district from July 28 to August 3, under the Directorship of Professors Lapworth and Watts, Dr Stacey Wilson, and Messrs Jerome Harrison and Wickham King. Messrs Sollas, Blake, Sherborn, and Miss Wood of Birmingham, were among the fifty or sixty persons present. Mr Frederick Meeon acted efficiently as Excursion Secretary. The main attraction of the Excursion was the comparison of the Archæan and Cambrian Rocks of the district with those seen on a previous occasion in the Shrewsbury area under the same directors. The clear and patient exposition of the "Old Boy," as Professor Lapworth calls the Archæan rock, was warmly acknowledged by the visitors, many of whom had followed for a second time this eminent leader in British geology. The basic dyke in Abel's Quarry, near Nuneaton, penetrating the Archæan, but cut off by the overlying Cambrian Quartzite, was an object of much interest, while the Hyolithes beds of Cambrian age yielded sparingly *Kutorgina*, *Hyolithes*, and other fossils. The remarkable bending of the edges of the Menevian beds underlying the Carboniferous conglomerate was examined in detail, and the theory of the movement of soil-cap was held to be sufficient to account for it without calling in any more violent means. The geologists were shown, by Professors Lapworth and Watts, the imaginary restoration of the old Triassic sea, with its islands of Charnwood, Nuneaton, Lickey, Shrewsbury, &c. The head of a trilobite was found for the first time in the Lower Stockingford Shales, thus helping forward the elucidation of the life of the period. The last day an excursion was made to the Dudley and Wren's Nest Silurian, and owing to the excellent arrangements made by Mr Claughton the workings were explored in boats in a most complete manner. Heavy bags were made, chiefly of rock-specimens, and a rumour was current a few days later that the Oxford express had broken an axle.

THE German Emperor, whose sympathy with all forms of literature, art, and science is notorious, must have had excellent reasons for prohibiting the intended meeting at Posen of the Polish Association for the Promotion of Medical and Natural Science, and for threatening with banishment any Prussian subject who should take part in the proceedings. That he should wish "to envenom the relations between the Polish and the German nationality," no sane man can believe; yet this is what is openly stated by sixty protestant professors in a circular addressed to leading members of the medical profession in Great Britain.

At the Congress of Chemists in Vienna, Dr Leo Lilienfeld, a former pupil of Du Bois Reymond, and now at Vienna, demonstrated a simple synthesis of albumen, or rather pepton, said to be similar in composition and reactions to the natural product as formed by the digestion of albuminous substances. The ingredients are said to be phenol, glyecol, amydo-acetic acid, monochlorine acetic acid, and phosphoric oxychloride. Whether the nutritive qualities of the compound are the same as those of natural pepton has yet to be proved. There is no immediate prospect of its replacing the roast beef of old England.

FROM the *Bolletino del Naturalista* we learn that a committee has been formed at Turin in order to establish there a freshwater aquarium for the advancement of pisciculture in Italy and specially in Piedmont.

ON August 1 the Public Library at Norwich was destroyed by fire. It had been founded over a century, and contained more than 60,000 volumes. The department of local archaeology was specially valuable, and many of the books so unhappily lost can never be replaced.

THE expedition of Mr C. E. Borchgrewink to the Antarctic is to sail early in October on board the 'Southern Cross,' built by Mr Colin Archer, architect of the 'Fram.' The scientific staff includes Sub-Lieutenant William Colbeck, R.N.R., and Mr Louis Bernacchi of the Melbourne Observatory, as magnetic officers; Dr Herlof Klövstad of Christiania Observatory, as medical officer; Messrs Nicolai Hansen and Hugh Evans, as zoologists and collectors.

THE Egyptian Geological Survey proposes to attack the Peninsula of Sinai during the coming winter. From Dr W. F. Hume, who, with Mr Skill as topographer, will survey regions as yet little explored, we look for some interesting results.

THE Congo Independent State intends to make a thorough scientific survey of Tanganyika. Twenty observation and experiment stations have already been built, and collections will be made of the flora, fauna, and geological specimens. The results have to be published at Brussels in a new periodical, the *Scientific Annals*, which will appear every six weeks.

AN expedition is being fitted out in Amsterdam for the zoological, botanical, and oceanographic exploration of the waters of the East Indian Archipelago. The leader will be Dr Max Weber, professor of zoology at Amsterdam University. He will be accompanied by Mrs Weber, who will have charge of the botanical section of the researches, and by Dr J. Versluys and Mr H. F. Nierstras, who will assist in zoology.

THE German deep-sea expedition, on the s.s. 'Valdivia,' of the Hamburg-American Line, Captain Krech, left Cuxhaven at 8 P.M. on August 1st, and crossed to Granton. Some successful trials of the apparatus were made on the way. The scientific staff consists of Prof. Chun of Leipzig, director; Prof. Schimper of Bonn as botanist, Drs Apstein and Vanhoffen of Kiel, and Dr Braem of Breslau, as zoologists; Dr G. Schott of Hamburg as oceanographer; Dr P. Schmidt of Leipzig as chemist. Navigating officer Sachae, Dr Bachmann of Breslau as bacteriologist and medical officer. Non-official members are the zoologists, Dr Brauer of Marburg a/L, and Dr zur Strassen of Leipzig; and Mr F. Winter of Frankfort, as draughtsman and photographer. The laboratories and cabins are spacious and admirably fitted up, and the ship is supplied with a fine scientific library. On the evening of August 4 the 'Valdivia' again sailed for the Faroe Channel; she will pass round the north of Scotland, and then go down to Cape Town, where she is due towards the end of November.

CORRESPONDENCE

PROGRESS AND PROVENDER

MR BERNARD modestly considers that the chief value of his entertaining paper "A new reading in the Annulate Ancestry of the Vertebrata" (*Nat. Sci.*, xiii., pp. 17-30, July 1898) lies in its exemplification (whether rightly or wrongly) of a factor in evolution hitherto not sufficiently emphasised, namely, "that the profoundest morphological transformations leading to the rise of new groups of animals can be traced to the adoption of new methods of feeding." Self-evident though the proposition seems, "yet I am not aware," he continues, "that it has ever been applied systematically except in the two cases in which I have myself endeavoured to apply it." From this it appears that he is ignorant even of the title of Mr A. T. Masterman's suggestive article "On some points in the general morphology of the Metazoa considered in connection with the physiological processes of alimentation and excretion" (*Zool. Anzeiger*, xix., pp. 190-198, 206-221, and 225-229—1896). On p. 228 of that paper, Mr Masterman says, "Reasons have been given for regarding the modifications of the alimentary processes to be the direct originators of other sets of organs, the instances of skeletal and pigmentary organs being taken as typical. If in phylogeny the various organs arise from and are intimately connected with, the alimentary processes, then in ontogeny the same will result. The first signs of differentiation will appear in connection with the sustentative function, and mechanical ingestive processes will lead the way."

That modifications of the alimentary processes have been the chief guides in the evolution of the classes of Echinodermata is a view that I never felt to be in need of emphasis. It has however been emphasised by Dr Otto Jaekel, who says, "The morphogeny of the Pelmatozoa depends essentially on two factors, on the one hand the development of the nutrient ciliated grooves of the ambulacra, which soon results in the formation of free arms, on the other hand those passive transformations which bring about a correlation of those structures with the rest of the body" (*Sitzber. Ges. naturf. Freunde Berlin*, 1894, p. 103).

Mr Bernard will doubtless be glad to find that a view which he holds so strongly and expresses so ably, is not likely to perish for lack of other support.

F. A. BATHER.

"THE STUDY OF VARIATIONS."

WHILE not wishing to unnecessarily prolong this subject, I should be glad if you would allow me to clear up some misconceptions in reference to the position I endeavoured to maintain in your magazine for April and June.

My position was based mainly on the immense difficulty experienced in determining the value of *small variations*, and the fact, equally patent, that when this had been accomplished there remained even more disputed questions in reference to the causes which had led to their production.

Instead of offering any theory of heredity, I merely put forward some suggestions which I thought might explain the causes of this endless dispute: for this reason I endeavoured, as far as possible, to approach the subject from a neutral position. As a matter of personal belief I think Mr Henslow and others have succeeded in demonstrating that variations are more definite in nature than Darwin believed. I did not need to state this conviction, because I *provisionally accepted* the facts adduced by Mr Henslow himself, which therefore made it quite unnecessary to bring forward any other evidence.

While admitting that his explanation was, from his point of view, justifiable, it yet appeared to me that the *same facts* were capable of explanation on another theory, which was itself merely the *necessary* corollary of Natural Selection. Thus merely by continually eliminating the less fit, and therefore leaving the more fit to survive and reproduce, the average range of variability must increasingly tend towards perfect adaptability, in exact proportion to the length of time and constancy of conditions operating on the organism. On this hypothesis those forms of life which are subjected to continuous conditions should have variations which are more definite in character than other forms which have a more varied and less constant environment, hence plant life generally as compared with animal should exhibit greater evidence of definiteness in its variability,

and because conditions are usually more powerful, and necessarily operate for shorter periods of time, when under man's direction than in nature, so variations should be correspondingly less definite in the domesticated forms of life.

This position also destroys the force of the two chief arguments used against Natural Selection by demonstrating *that it is itself able to induce those favourable variations, which it subsequently selects from*. Firstly, it is urged that Natural Selection being unable to produce definite variations must be dependant on some other factor until the variations are sufficiently far advanced to be of selective value, and it is therefore incompetent to solve the most important question in the formation of species; secondly, the number of coincidences, which are necessary to perpetuate any given favourable variation on the assumption of *indefinite variability*, are so great that Natural Selection must be regarded, at best, only as a subordinate factor. By showing that, if natural selection acts at all, it must tend to produce definite variations, these two objections are largely overcome, and the facts adduced by the Neo-Lamarekian school easily accounted for. Hence with two competing theories to explain species formation, it becomes necessary to make a further appeal to facts to determine the value of each.

I feel so convinced of the importance of this aspect of the subject that I should be sorry if any want of clearness on my part at all obscured the point at issue.

J. LIONEL TAYLER.

THE GROTTO, HAMPTON-ON-THAMES.

NOTICE

TO CONTRIBUTORS.—All Communications to be addressed to the EDITOR of NATURAL SCIENCE, at 29 and 30 Bedford Street, London, W.C. Correspondence and Notes intended for any particular month should be sent in not later than the 10th of the preceding month.

TO THE TRADE.—NATURAL SCIENCE is published on the 25th of each month; all advertisements should be in the Publishers' hands not later than the 20th.

TO OUR SUBSCRIBERS AND OTHERS.—There are now published TWELVE VOLUMES OF NATURAL SCIENCE. Nos. 1, 8, 11, 12, 13, 20, 23, 24 being OUT OF PRINT, can only be supplied in the set of first Four Volumes. All other Nos. can still be supplied at ONE SHILLING each.

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